Summative Evaluation of EOT-PACI's Efforts within the Advanced Networking with Minority-Serving Institutions (AN-MSI) Project
May 2000- May 2003

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1. The EOT-PACI AN-MSI project and its goals:

In September 1999, the National Science Foundation awarded a $6-million grant to EDUCAUSE with a $1-million subcontract to the Education, Outreach, and Training coordinators of the Partnership for Advanced Computational Infrastructure (EOT-PACI) for a four-year collaborative effort called the Advanced Networking with Minority-Serving Institutions (AN-MSI) Project.[1] The overarching goal of the AN-MSI project was to assist minority-serving institutions (MSIs) in developing their computer and networking infrastructure, technical support staff, and national connections to become full participants in computer-aided education and research. MSIs include Historically Black Colleges and Universities (HBCUs), Hispanic-Serving Institutions (HSIs), and Tribal Colleges and Universities (TCUs). EOT-PACI's role in the AN-MSI project was to assist MSIs in developing the computational infrastructure and skills needed to utilize high-performance computer applications and resources (HPC) such as the Access Grid being prototyped by the PACI program. Through EOT-PACI's programs and workshops, interested MSIs would learn how to utilize the advanced technology available through PACI's Access Grid and other high-speed connections to the Internet or would be assisted in developing their own high-performance computing clusters on campus. EOT-PACI's national partnership of educators and outreach specialists in computational science has been working to increase the representation of ethnic minorities in the computational sciences since its establishment in 1997 with a grant from the NSF. The partnership consists of two separately funded branches: the National Partnership for Advanced Computational Infrastructure (NPACI) and the National Computational Science Alliance (NCSA). NCSA was the branch most directly involved with the AN-MSI project, but NPACI partners provided significant support in some workshops.

The overarching goal of EOT-PACI's AN-MSI effort was to increase the participation of MSI researchers and faculty in computational science education, research, and development and to increase their representation within PACI's high-performance computing projects, collaborations, and workshops. The supporting goals used as steps in meeting this overarching goal were the following:
1. Show MSI representatives the possibilities of HPC technology and inspire them to think about how such technologies could be used by their schools.
2. Include MSIs in HPC-related activities and conferences in which they weren't included in the past, both to raise the awareness of MSI researchers about high performance computing and to lay the foundation for potential researcher collaborations.
3. Assist in launching collaborations and developing linkages between computational science researchers at MSIs and their peers at majority institutions and HPC research centers.

A professional evaluator from the UW-Madison's LEAD Center began working with EOT's AN-MSI coordinators in June of 2001 to help them evaluate their progress toward these goals and collect formative feedback that could be used to refine their strategies. This final evaluation report

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[1] The grant (ANI-9980537) came from the Advanced Networking Infrastructure and Research division of NSF's Computer and Information Science and Engineering directorate.

summarizes the outcomes of EOT's AN-MSI efforts from May 2000 (the date of EOT's first AN-MSI workshop) through July 2003 (the date of the final workshop).

2. Overview of EOT's AN-MSI workshops and activities:

EOT-PACI's efforts within AN-MSI were concentrated on the following workshops and activities:

1. MSI High-Performance Computing Workshop Series (five workshops from May 2000 to September 2002): This series of workshops, developed and run by representatives and partners from the NCSA branch of EOT-PACI, was intended to give MSI faculty and staff hands-on training in high-performance-computing hardware and the software needed to run it. The first two workshops at the NCSA ACCESS[2] Center in Arlington, VA (May 2000 and April 2001) focused on demonstrating and explaining how to use NCSA's HPC resources like the Access Grid and supercomputers. The final three workshops, held in San Diego (March 2002), Urbana (May 2002), and Atlanta (September 2002) focused on the installation and use of HPC clusters (desktop PCs linked together to run HPC applications) because this is the most affordable means of obtaining high-performance computing for many of the participating MSIs. These workshops, referred to as the MSI Cluster Computing Workshops, were developed and run in partnership with the Shodor Foundation's National Computational Science Institute (NCSI) and were timed to coincide with three annual computing conferences: the NPACI All Hands Meeting, the Alliance (NCSA) All Hands Meeting, and the EDUCAUSE Conference. Participants in these three workshops generally attended the conference before or after attending the workshop. The first two HPC workshops were evaluated by the developers, and the three Cluster Workshops were evaluated by LEAD.

2. SC Minority-Serving Institutions Participation Project (three cohorts attending events at the SC (SuperComputing) conference in 2000, 2001, and 2002): The purpose of this project was to bring a sizeable group of MSI representatives to the annual SC conference to be exposed to all that high-performance computing has to offer; network with other MSI researchers, HPC researchers at majority institutions, and HPC vendors; see exhibits and presentations on the latest technology and applications; and participate in discussions on how to bring more minorities into high performance computing. EOT-PACI obtained additional funding for the project through two 2-year grants from IEEE and ACM.[3] The first MSI Participation Project at SC'00 in Dallas had 12 participants. The project at SC'01 in Denver had 30 participants, and the project at SC'02 in Baltimore had 44 participants. MSI representatives participating in the project received funding for conference registration, travel to and from the conference, and room and board during their stay. In addition to attending the conference's regular exhibits, panels, papers, posters, and sessions, participants attended an MSI Welcome Reception and a Birds-of-a-Feather discussion focused on minority leadership and representation in HPC activities. The first SC MSI participation project was evaluated by project administrators, while the SC'01 and SC'02 versions were evaluated by LEAD.

3. MSI HPC Working Group (established in March 2002): This effort grew out of conversations with and evaluation feedback from participants in the SC'01 MSI Participation Project. Participants found great value and promise in the connections they established at SC with other MSI representatives interested in HPC, and they sought ongoing opportunities for interaction and information exchange. The EOT-PACI representative fulfilled this request by

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[2] Alliance Center for Collaboration, Education, Science, and Software
[3] Institute of Electrical and Electronic Engineers; Association for Computing Machinery

establishing the MSI HPC listserv and the MSI HPC Working Group. All ten MSI representatives in the initial Working Group were SC'01 attendees. The group held its kickoff meeting at the NCSA ACCESS Center in March 2002 and has continued to hold group discussions ever since via face-to-face meetings, conference calls, and messages on the MSI HPC listserv. Its mission is to "chart a path" for other MSIs interested in bringing HPC technology to their campuses. The group, which now includes members from 13 MSIs, has developed a survey to explore MSIs' interests and needs with regards to HPC. Group members also search for opportunities to engage in collaborative proposals and to obtain funding for their institution's HPC projects. Five members of this group were interviewed by the LEAD Center in April 2002 about the goals and benefits of Working Group participation.

4. <u>HPC-related demonstrations and discussions for MSI representatives </u>(3 events from August 2000 to March 2001): In the first 18 months of the ANMSI Project, EOT-PACI's primary form of outreach to MSIs was through HPC-related demonstrations and discussions held at locations that were convenient for MSI representatives to attend. The purpose of these demonstrations and discussions was to inform MSI representatives about the benefits of HPC technology and the HPC programs and workshops that EOT-PACI was developing through the AN-MSI project. The first event was held in August 2000, when 24 participants from HBCUs in the Atlanta area joined the Alliance Chautauqua 2000 conference using an Access Grid node that EOT-PACI temporarily installed at the Clark-Atlanta University. The next event was the Global Grid Forum held in Boston in October of 2000, for which EOT-PACI provided funding for five MSI representatives to attend. The third event was the HPC demonstration held at the annual American Indian Higher Education Consortium (AIHEC) Conference in Duluth in March 2001.

5. <u>Providing select MSIs with permanent Access Grid nodes to connect their institutions to national HPC networks</u>: In July of 2003, EOT-PACI brought representatives from the following seven MSIs to Bethune-Cookman College in Daytona Beach to receive the hardware and training needed to connect their institutions to the Access Grid: Bethune-Cookman College, Clark-Atlanta University, Florida A&M University, Florida International University, Fond du Lac Tribal & Community College, Our Lady of the Lake University, and the University of Texas at El Paso.

6. <u>NSF Proposal Writing Workshop</u> (One event in March 2003): Eighteen faculty and staff from MSIs and minority-focused technology organizations participated in a proposal preparation workshop co-sponsored by the National Science Foundation (NSF) and EOT-PACI's AN-MSI group. The two-day workshop was held at the NCSA ACCESS Center in Arlington. The purpose of the workshop was to give participants detailed instruction in how to develop and write competitive grant proposals for the NSF's numerous technology-related grant programs. The workshop was evaluated with post-workshop evaluation surveys developed by the LEAD Center. Additional workshops on proposal-writing may be held in the future, pending the availability of funds.

7. <u>Providing ad hoc funding for MSI representatives to attend HPC-related workshops</u>: Over the course of four years, 12 MSI representatives received EOT-PACI funds to attend workshops related to HPC. This included four individuals who were given training in the Access Grid at the Argonne National Lab in March 2000, two who attended the Modeling and Visualization Workshop at the NCSA ACCESS Center in October 2000, one who

attended the Global Grid Forum in Toronto in February 2002, and five who attended the Access Grid Technical Retreat at Argonne National Laboratory in April 2003.

Table 1 shows the number of representatives from Historically Black Colleges and Universities (HBCUs), Hispanic-Serving Institutions (HSIs), Tribal Colleges and Universities (TCUs), and MSI-focused technology organizations (Others) that attended each of the 17 events or workshops sponsored or co-sponsored by EOT-PACI as part of the AN-MSI project. The last three rows in the table show: (1) the total participant count for each community at EOT-PACI AN-MSI events, (2) the total number of *individuals* from each community that attended one of more of EOT-PACI's sponsored events, and (3) the percent of the 156 participating individuals who came from each of the four communities.

Table 1: Participation in 17 events sponsored by EOT-PACI through the AN-MSI project

EOT-PACI AN-MSI event	Location	Date	HBCU reps	HSI reps	TCU reps	Others	Total
MSI HPC Workshop #1	Arlington	May-00	7	5	5		17
AG training for Atlanta Chautaqua	Argonne Lab	Mar-00	4				4
Atlanta Link to Chautauqua 2000	Atlanta	Aug-00	24				24
Global Grid Forum #3	Boston	Oct-00	2	1	2		5
Modeling & Visualization Workshop	Arlington	Oct-00	1	1			2
SC'00 MSI Participation Project	Dallas	Nov-00	6	4	2		12
AIHEC HPC Demonstration	Duluth	Mar-01					NA
MSI HPC Workshop #2	Arlington	Apr-01	11	2	5		18
SC'01 MSI Participation Project	Denver	Apr-01	20	7	3		30
MSI Cluster Computing Workshop #1	San Diego	Mar-02	6	6	4		16
Global Grid Forum #4	Toronto	Feb-02	1				1
HPC Working Group Kickoff Meeting	Arlington	Mar-02	8	1	1		10
MSI Cluster Computing Workshop #2	Urbana	May-02	14	7			21
MSI Cluster Computing Workshop #3	Atlanta	Sep-02	5	8	5		18
SC'02 MSI Participation Project	Baltimore	Nov-02	28	10	6		44
NSF Proposal Writing Workshop	Arlington	Mar-03	10	4	1	3	18
Argonne Technical Retreat 2003	Argonne Lab	Apr-03	4	1			5
Total participant count			151	57	34	3	245
Total # of individuals at 1 or more event			92	38	23	3	156
% of individuals from each community			59.0%	24.4%	14.7%	1.9%	100%

Table 2 lists the total number of events attended for the 156 individuals represented in Table 1. As the table shows, 31% of the participants in EOT-PACI's AN-MSI events attended more than one such event. Participants in multiple events were more likely to become involved in sustained HPC activities like the MSI HPC Working Group.

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Table 2: Participation levels for the 156 participants in EOT's AN-MSI events

Participation level	# of individuals at that level	% of total
6 events	1	0.6%
5 events	5	3.2%
4 events	7	4.5%
3 events	8	5.1%
2 events	27	17.3%
1 event	108	69.2%
Total	156	100.0%

Overall, there were 23 HBCUs, 17 HSIs, 13 TCUs, and 4 minority-serving technology organizations represented at AN-MSI events sponsored by EOT-PACI. Appendix A lists the 54 MSIs and 3 organizations that had representatives attend at least one EOT-PACI AN-MSI event.

3. Evaluation Methodology:

As mentioned in Section 2, half of EOT-PACI's AN-MSI events and activities were evaluated by the LEAD Center, while the other half occurred before or after the period of LEAD's evaluation and were instead evaluated by project administrators. The LEAD evaluator assessed all of EOT-PACI's AN-MSI participation projects and workshops from June of 2001 to May of 2003. These included the three MSI Cluster Computing Workshops co-sponsored by the Shodor Foundation, the last two years of the SC Minority Participation Project co-sponsored by IEEE and ACM, the Proposal Writing Workshop co-sponsored by NSF, and the launching of the MSI HPC Working Group. All of these events, with the exception of the Working Group, were evaluated using post-activity surveys that 80-100% of participants returned (and in the case of SC'01, the evaluation also included a pre-activity survey and a discussion sheet filled out by participants in the Birds-of-a-Feather discussion). The LEAD evaluator attended and made field observations at the SC'01 Minority Participation Project in Denver and the MSI Cluster Computing Workshop in San Diego. The evaluator tracked and read all postings on the MSI HPC Listserv and interviewed five members of the HPC Working Group (all of whom had participated in other EOT-PACI AN-MSI events) in April of 2002. Four other participants in EOT-PACI's various AN-MSI events were interviewed the same month, for a total of nine participant interviews. There was insufficient funding for the evaluator to perform interviews or attend EOT-PACI events in 2003, but development, administration, and analysis of post-workshop surveys continued through the summer of 2003.

4. Outcomes of EOT-PACI AN-MSI programs and workshops subject to LEAD evaluation:

This section provides a summative analysis of the particular programs and workshops evaluated by the LEAD Center from June 2001 to May 2003. Section 5 contains an examination of the systemic impact of EOT-PACI's AN-MSI activities on particular minority-serving institutions.

4.1 MSI Cluster Computing Workshops:

All five of the MSI HPC Workshops were intended to address the goal of showing MSI representatives the possibilities of HPC technology and inspiring them to think about how their schools could use such technologies. As time went on, the need for more explicit hands-on training

in HPC tools and applications became apparent. The MSI Cluster Computing Workshops grew out of EOT-PACI's experiences with the first two MSI HPC Workshops and with arranging to set up Access Grid nodes at various MSIs in the first two years of the project. These experiences and conversations with participants had convinced EOT-PACI that the most affordable means for many MSIs to get involved in high-performance computing would be to have them set up HPC clusters using regular PCs on their own campuses. The team at NCSA developed a portable HPC cluster called "Cluster in a Box," and the EOT-PACI team worked with them in developing manuals, tutorials, and a workshop that could be used to train faculty and staff in setting up their own HPC clusters. From this arose the three MSI Cluster Computing Workshops, the first of which was held in March 2002 in conjunction with the NPACI All Hands Meeting in San Diego. EOT-PACI recruited one of their partners, the Shodor Foundation, to give demonstrations of the utility of high-performance modeling and visualization tools in teaching math and science. Because this workshop and the second one in Urbana were held in conjunction with PACI All Hands Meetings at the partnership's two supercomputer centers, workshop participants also got to attend the PACI conferences and tour the supercomputer facilities. Then, using the hands-on training they had received at the two-day workshops, participants could return to their campuses and set up clusters of their own. According to interviews performed for the larger AN-MSI project, at least six workshop participants have set up clusters to date, and at least two of the MSIs that now have clusters in place because of the Cluster Computing Workshops have begun using those clusters in research or teaching.

Table 3 shows the number of participants from each community at the three MSI Cluster Computing Workshops. The size of the workshops has fluctuated depending on both interest and timing, with no applicants being turned away. The workshops were advertised through the various AN-MSI and MSI HPC Working Group listservs and in presentations at tri-annual AN-MSI meetings.

Table 3: Number of participants in the MSI Cluster Computing Workshops

MSI Cluster Computing Workshops	Date	HBCU reps	HSI reps	TCU reps	Total
Workshop #1-San Diego	Mar-02	6	6	4	16
Workshop #2-Urbana	May-02	14	7		21
Workshop #3-Atlanta	Sep-02	5	8	5	18
total participant count		25	21	9	55
% of all participants		46%	38%	16%	100%

All three workshops were evaluated using a post-workshop survey that asked participants about their experiences and had them rate the usefulness of the workshop's presentations and activities and the quality of various aspects of the workshop. For each workshop, the surveys were returned by 89-100% of participants, for an average response rate of 95%. Small changes in the workshop series were made as a result of evaluation feedback or changes of venue (for example, the workshops at San Diego and Urbana included tours of supercomputer centers, while the one in Atlanta did not). However, there were many common elements across all three workshops, and participants' ratings for these were, on the average, exceptionally high, with only one item receiving an average rating lower than 4.00 (a 3.87 for one presentation during the first workshop). The workshops as a whole always received average ratings above 4.5 (#1 = 4.58, #2 = 4.73, and #3 = 4.64, for an average of 4.66 across all three workshops). In short, the vast majority of participants were highly satisfied with the usefulness and quality of the MSI Cluster Computing Workshops.

Tables 4 and 5 show participants' ratings for all workshop elements. Because there were only small fluctuations in the average ratings from workshop to workshop, the ratings have been combined across all three workshops.

Table 4: Participants' ratings for the presentations and activities of the Cluster Computing Workshops

Cluster Workshop presentations & activities (in order of occurrence)	Very Useful				Not Useful	Mean	Total N
	5	4	3	2	1	Mean	Total N
Examples of HPC across the curriculum	64%	32%	2%	2%		4.58	50
Demo on 5-PC Cluster	61%	33%	6%			4.55	49
Cluster Computing overview	49%	33%	12%	6%		4.25	51
Install a cluster demo	71%	14%	8%	8%		4.47	51
Shodor's one-on-one tutorial (optional)	62%	31%			8%	4.38	13
Future of clusters: latest in cluster development	64%	22%	12%	2%		4.48	50
Use of clusters from an MSI perspective	76%	19%	3%	3%		4.68	37
Hands-on cluster install using OSCAR	73%	20%	2%	5%		4.61	41
Sample cluster Jobs/Applications	48%	36%	15%			4.33	33
NAMD example (Workshop #3 only)	91%	9%				4.91	11
Installing classroom cluster with LTSP (#3 only)	67%	27%		7%		4.53	15
The workshop overall	71%	24%	5%			4.66	41

Table 5: Participants' ratings for various aspects of the Cluster Computing Workshops

Aspects of Cluster Workshop (from highest-rated to lowest-rated)	Excellent				Poor	Mean	Total N
	5	4	3	2	1	Mean	Total N
Organization of workshop by coordinators	81%	15%	4%			4.77	52
Facility conducive to learning	71%	27%	2%			4.69	51
Audiovisual/projection aids	69%	29%	2%			4.67	51
Value of workshop to my future duties	59%	31%	6%	4%		4.45	51
Showed me research possibilities w/ clusters	61%	29%	2%	8%		4.43	51
Value of workshop to my present job	58%	29%	10%	4%		4.40	52
Workshop length	50%	33%	17%			4.33	52

When participants were asked to what extent the workshop allowed them to "return to your organization with increased knowledge and abilities for your research and for new learning experience for your students," 38 of 50 respondents (76%) said "very much" and 12 (24%) said "moderately."

When participants were asked asked if they were interested in attending an additional workshop on high performance computing, 48 of 51 respondents (96%) said "Yes," 3 (6%) said "Not sure," and none said "No."

According to their survey responses, participants' main goals in attending the cluster workshop had been: (1) gaining an introduction to HPC clusters and how they are used, (2) getting hands-on instruction in designing and installing HPC clusters, and (3) learning more about the educational applications available for HPC clusters and how to incorporate them into the curriculum. When asked if they met their goals, 42 of 50 respondents (84%) said, "Yes," 4 (8%) said, "Not sure," and 4 (8%) said, "No." Participants' open-ended comments suggested that the EOT-PACI MSI Cluster Computing Workshops did a solid job at addressing the first two goals, but that the last item—in-depth exploration of educational applications—needs to be dealt with in more detail or covered in a separate workshop.

Perhaps the primary benefit of the HPC Cluster Workshops was showing MSI representatives how simple and accessible Cluster Computing could be, even for schools with small IT budgets. One interviewee described how attending the cluster workshop made her realize that her institution could develop the capacity for HPC-facilitated research right on its own campus. "The Cluster Workshop was so enlightening," she said. "What's so wonderful about clusters, once you realize what they are, is that it makes high performance computing accessible to any school that wants it. It shows you, 'Hey, we can do this! With our own PCs!' Knowledge is power."

After the workshops had concluded, CD-ROMs were developed containing information from the workshops, tutorials, and links to other resources. This MSI resource on cluster computing is also available online at http://www.ncsa.uiuc.edu/Divisions/AccessInclusion/cd-rom/index.html.

4.2 SC Minority-Serving Institutions Participation Project:

This project was designed to meet all three of EOT-PACI's supporting goals within the AN-MSI project: To show MSI representatives the possibilities of HPC technology, to include more MSIs in HPC conferences in which they have been largely unrepresented, and to assist in launching collaborations between computational scientists at MSIs and their peers at majority institutions and HPC research centers. The MSI Participation Project attempted to address these goals by sponsoring a sizeable group of MSI representatives to attend the annual SC conference. At this conference, they would: (1) see exhibits and presentations on the latest HPC technology and applications; (2) network with other MSI researchers, HPC researchers at majority institutions, and HPC vendors; (3) and participate in discussions on how to bring more minorities into high-performance computing. Participants in the project received funding for conference registration (not including tutorials), travel to and from the conference, and room and board for several nights stay. Because of limited funding, enrollment in the project was competitive, with a small percentage of applicants being turned away each year. SC events were generally spread over seven days in November, and always included an MSI Welcome Reception and a Birds-of-a-Feather discussion on minorities in computing sponsored by EOT-PACI. Participants' average length of stay at SC was five days, with a minimum of three and a maximum of seven.

Table 6, which shows the number and background of the participants across the three years of the MSI Participation Project, illustrates the success of the project in attracting increasing numbers of MSI faculty and staff to attend the SC conference. Attendance figures by race are not available for the SC conference as a whole, but because three-quarters of these minority representatives had not attended SC in the past and previous attendees reported seeing very few other minorities, it is safe to assume that the SC Minority Participation Project substantially increased the attendance of underrepresented minorities at the SC conference.

Table 6: Number of SC MSI Participation Project participants from each MSI community for each year of the project

SC Conference	HBCU reps	HSI reps	TCU reps	Total	# who hadn't attended SC previously
SC'00-Dallas	6	4	2	12	10 (83%)
SC'01-Denver	20	7	3	30	21 (70%)
SC'02-Baltimore	28	10	6	44	31 (70%)
Total	54	21	11	86	62 (72%)
% of participants	63%	24%	13%	100%	

The LEAD evaluator conducted an intensive evaluation of the MSI Participation Project (pre- and post-conference surveys, discussion group worksheets, field observations, and some participant interviews) at SC'01, and a less intensive evaluation (post-conference surveys only) at SC'02. The post-conference evaluation surveys were completed by 73% of participants at SC'01 and 74% of participants at SC'02. Differences in survey responses between years were small, so the data for both years are combined in the survey analyses that follow.

Participants were asked which of the following activities they engaged in at SC. The activities are listed by how many (and what %) of the 54 survey respondents engaged in them, from the most frequently engaged in to the least frequently engaged in:

48 (79%) met and networked with people involved in technology at MSIs.
47 (77%) checked out new products and demos on the exhibition floor.
45 (74%) learned more about the field of HPC generally.
42 (69%) met and networked with researchers/professionals in HPC.
39 (64%) met and networked with vendors whose products may be useful to them.
39 (64%) furthered their relationship with EOT-PACI/NCSA.
37 (61%) attended talks or posters relevant to their teaching/administrative duties.
32 (52%) attended talks, papers, or posters relevant to their research.
25 (41%) got training in some aspect of HPC through a tutorial or workshop.
16 (26%) fulfilled a request by someone at their institution.
8 (13%) showcased their research in the SC Academic Village.

As one can see from the responses above, the majority of participants engaged in numerous activities at SC that addressed the three major goals of EOT-PACI's AN-MSI efforts. When asked to elaborate on the most important and beneficial aspects of their SC experience, participants emphasized the following:

➢ Seeing the latest uses of HPC in research and education and becoming inspired about its possibilities at their own institutions.
➢ Networking with peers at MSIs who were interested in or already exploring HPC research and education.
➢ Forming a community of like-minded computational scientists and technical experts at MSIs.
➢ Making valuable connections with HPC vendors and HPC researchers at majority institutions with whom they might work in the future.
➢ Attending the presentations and tutorials associated with SC's Education Program, which provided demonstrations and training for HPC applications used in the classroom.

Survey respondents were asked to rate on a scale of 1-5 how well the SC conferences and the MSI Participation Project did at providing them with eight different networking, training, and learning opportunities. On this 5-point scale, a rating of 1 = Poor and a rating of 5 = Excellent. Table 7 shows the percentage of respondents who picked each rating and the average rating for each opportunity.

Table 7: Participants' ratings of opportunities provided by SC and the MSI Participation Project

How well did the SC conference and the MSI Participation Project do at providing the following?	Excellent				Poor	Mean rating	Total N
	5	4	3	2	1		
Networking with HPC researchers, professionals, & vendors	48%	30%	13%	9%		4.17	54
Encouragement for minority/MSI researchers to become more involved in HPC	61%	30%	6%	4%		4.48	54
Knowledge about cutting-edge HPC technology and applications	56%	30%	13%		2%	4.37	54
Knowledge about HPC products relevant to my institution or research	49%	42%	6%	4%		4.36	53
Networking with technology experts at MSIs	51%	36%	11%	2%		4.36	53
Networking with people with whom I might collaborate on future projects or grant proposals	43%	42%	11%	2%	2%	4.23	53
HPC resources or references that will be useful to me	42%	43%	11%	2%	2%	4.21	53
Useful training in HPC technology and applications	26%	30%	25%	13%	6%	3.58	53

Survey respondents were also asked about the usefulness of the Birds-of-a-Feather discussion about minorities in HPC that was sponsored by EOT-PACI. From the 51 respondents who reported attending it, the responses were the following:

       23 (45%) said it was "exceedingly useful"
       25 (49%) said it was "useful to a large extent"
       2 (4%) said it was "somewhat useful"
       1 (2%) said it was "not at all useful"

Finally, survey respondents rated the overall information, opportunities, and support they obtained through the SC MSI Participation Project in the following way:

       35 (67%) said "excellent"
       14 (27%) said "very good"
       3 (6%) said "good"
       No respondents rated the project as only "adequate" or "poor"

Many participants in the MSI Participation Project found their experience with the project eye-opening and inspiring. Indeed, participant feedback collected after the conference showed that many participants were anxious to continue the discussions and collaborations they had begun at SC, and it was for this reason that the MSI HPC Working Group and listserv were formed. One typical survey respondent said the Participation Project was "extremely useful…I think exposure is key in making it relevant to MSI representatives. The combination of seeing the tools, talking with researchers, and brainstorming with colleagues opened the door for me." Another typical respondent emphasized how important the project was in allowing MSI representatives like him to "network with HPC professionals that were in my field, establish relationships for future collaboration experiences, learn about the new technology in the field, and find out what people were doing in my area with the new technology. I really enjoyed the presentations."

4.3 NSF HPNC Proposal Writing Workshop:

Eighteen faculty and staff from 13 Minority Serving Institutions and 3 minority-focused technology organizations participated in the proposal writing workshop co-sponsored by the National Science Foundation and EOT-PACI. The purpose of the two-day workshop held in March 2003 was to give participants detailed instruction in how to develop and write competitive grant proposals for the NSF's numerous technology-related grant programs. Eight of the 14 male and 4 female participants had participated in other AN-MSI workshops sponsored by EOT-PACI in the last two years. Participant feedback on the workshop was collected through a post-workshop evaluation survey, which 17 of the 18 workshop participants completed, for a response rate of 94%.

Survey respondents were asked to rate the usefulness of workshop presentations and events on a 5-point scale where 5 = Very Useful and 1 = Not Useful. They were then asked to rate various aspects of their workshop experience on a 5-point scale where 5 = Excellent and 1 = Poor. Tables 8 and 9 summarize how many of the 17 survey respondents gave a particular rating for each item and the mean rating for each item.

Table 8: Participants' ratings of the Proposal Writing Workshop's presentations and events	Very Useful 5	4	3	2	Not Useful 1	Mean
Bailey-Thomas's FastLane Submission Guidelines	14	3	0	0	0	4.82
Monaco's Overview of Cost Sharing & Allowable Costs	13	4	0	0	0	4.76
VanBelleghem's Discovery via Network Connections	13	3	1	0	0	4.71
Monaco's Proposal Review Process	10	5	0	0	0	4.67
VanBelleghem's Sustainability & Extension Plan	11	6	0	0	0	4.65
Been's Examples of Successful Proposals	11	6	0	0	0	4.65
Monaco's Overview	10	4	1	0	0	4.60
Hilderbrandt's Overview	9	5	1	0	0	4.53
Powell's Network & Research Applications	10	6	1	0	0	4.53
Lathrop's Network & Research Applications	11	4	2	0	0	4.53
Peabody's Network Engineering Plan	9	5	2	0	0	4.44
Monaco's Education & Training Plan	10	4	3	0	0	4.41
Giles's Network & Research Applications	9	5	3	0	0	4.35
The workshop overall	13	2	1	0	0	4.75

Table 9: Participants' ratings of aspects of the Proposal Writing Workshop	Excellent 5	4	3	2	Poor 1	Mean
Audiovisual/projection aids	16	1	0	0	0	4.94
Organization of workshop by coordinators	15	1	1	0	0	4.82
Value of workshop to my institution's needs	14	3	0	0	0	4.82
Value of workshop to my future duties	13	4	0	0	0	4.76
Workshop length	14	2	1	0	0	4.76
Facility conducive to learning	13	4	0	0	0	4.76

As is clear from these tables, the workshop was regarded as useful and well-run by the vast majority of respondents. Fifteen of 16 respondents to the question (94%) gave the overall workshop a usefulness rating of "5" (81%) or "4" (13%) on a 5-point scale, and one respondent (6%) gave the workshop the mid-point rating of "3." The mean ratings for each of the workshop's 13 presentations were all between 4.82 and 4.35, and the mean ratings for each of the workshop's six aspects were all between 4.94 and 4.76. No respondent gave a rating lower than "3" (the midpoint) for any item on either scale.

When asked to what extent the workshop helped them to "return to their organization with increased knowledge and abilities for preparing a successful proposal," 16 of 17 respondents to the question (94%) said "very much" and the other respondent said "moderately." When asked if they "met their goal in attending the workshop," all 16 respondents to the question (100%) said "yes." When asked if they "would like to attend another workshop on proposal writing, collaboration, or other topics," 16 of 17 respondents to the question (94%) said "yes."

5. The systemic impacts of EOT-PACI's AN-MSI efforts on particular MSIs:

The information available on the systemic impacts of EOT-PACI's AN-MSI efforts on particular minority-serving institutions comes from: (1) interviews with EOT-PACI workshop and project participants performed in April 2002, (2) follow-up interviews with some of these participants performed in February 2003 as part of the overall AN-MSI evaluation, (3) postings on the MSI HPC listserv, and (4) enrollment information from EOT-PACI's workshops and programs.

In April of 2002, the LEAD evaluator interviewed nine MSI representatives (seven males, two females) who had participated in at least one EOT-sponsored AN-MSI event over the past year (four had participated in three events, and three had participated in two events). Two of these interviewees were their campus's CIO, three were other technical staff members, three were faculty members, and one was a campus administrator still involved in technical research. Altogether they represented four HBCUs, two HSIs, and two TCUs. The purpose of these interviews was to collect more in-depth information about the perceived usefulness of EOT's AN-MSI events and the impact that EOT's efforts were having on the campuses of frequent participants.

The institutions from which interviewees came differed considerably with regards to their degree of technological development and the degree of support for faculty and researchers interested in high-performance computing. Represented in this group were two MSIs that had been working with EOT-PACI for several years and already had infrastructures that supported some HPC, including on-site clusters and high-speed Internet access to established supercomputer centers. Although these two MSIs are better equipped for HPC use than the vast majority of MSIs, they still lag behind the capacities of the major research institutions that participate in EOT-PACI. Another interviewee was from an engineering-focused HSI in Puerto Rico which had been using HPC workstations, clusters and high-speed connections to other universities in Puerto Rico for some time, but which still lacked a reliable high-speed connection to the mainland (a connectivity need which the EDUCAUSE branch of AN-MSI has been working to address). Three interviewees came from HBCUs and an HSI that were in the middle-ranges of MSI technological development: their Internet access and campus networks were fairly reliable and all three schools had some faculty and IT staff interested in HPC, but these institutions still needed staff training and a better understanding of the benefits of HPC. Also represented were two Tribal schools that were struggling with obtaining and keeping well-trained technical staff at their isolated reservation schools. One of these schools—typical of most TCUs—has out-of-date computers and unreliable Internet access in addition to their staffing problem. The other TCU has recently built a new computer center with higher-speed machines and classrooms wired for distance learning, but they haven't been able to find enough IT staff to take full advantage of the facility. These eight schools represented the full range of technical development found at MSIs nationwide.

5.1. EOT-PACI's impacts on MSIs that were already using HPC:

Early in the AN-MSI project, EOT-PACI focused its efforts on MSIs that already had the technological infrastructure and the budgets to support high-speed Internet access and purchase workstations to run HPC applications. Prior to the AN-MSI grant, EOT-PACI had already partnered with comparatively well-wired MSIs like the University of Houston-Downtown and Clark-Atlanta University. The University of Houston-Downtown has its own high performance computing center, and both universities already have minority faculty members specializing in supercomputing. It was these MSI faculty members who acted as EOT's advisers in the early stages of the AN-MSI project, helping to develop the early MSI HPC Workshops and doing presentations as part of the SC MSI Participation Project. As a result, their institutions also received most of the early benefits of the project, including funding for faculty and staff to attend conferences and workshops related to HPC. These schools' comparatively high degree of technical advancement at the start of the AN-MSI project made it harder for EOT-PACI to have as large of an impact on their overall HPC development as with less-advanced schools. However, on an individual level, faculty and staff at schools like the UH-Downtown said they benefited a great deal from their attendance at EOT-PACI-sponsored conferences and workshops and from strengthening their connections to the majority institutions involved in EOT-PACI.

5.2. EOT-PACI's impacts on technologically ambitious MSIs with little prior exposure to HPC:

As the AN-MSI project matured, EOT-PACI's efforts shifted beyond the most technologically sophisticated MSIs to include MSIs in the "second tier" of technological development: schools that had or would soon have sufficient Internet access and IT funding to allow forays into high-speed computing but that were only just beginning to develop the skills and on-campus resources necessary to take advantage of HPC applications. Examples of such schools include HBCUs like Bethune-Cookman College and Winston-Salem State University. Interviewees from both institutions said they worked extensively with EOT-PACI to give their faculty and staff training in HPC, set up their own clusters, and establish Access Grid nodes. Both of these schools were also extensively involved in the EDUCAUSE portion of the AN-MSI project and received considerable benefits from their participation in those events, including training and professional development for IT staff, and funding and equipment for IT infrastructure improvements. From the numbers of participants in EOT-PACI activities, it appears that second-tier schools like these have shown the greatest interest in EOT's AN-MSI workshops and the greatest commitment to providing personnel for efforts like the MSI HPC Working Group. The two sections below elaborate on the experiences of these HBCUs to illustrate EOT-PACI's impact on MSIs that had had little exposure to high-performance computing prior to the AN-MSI project.

Bethune-Cookman College: Bethune-Cookman College, a small HBCU in Daytona Beach, is one example of the impact that consistent involvement in EOT-PACI's AN-MSI activities can have on an institution as a whole. Bethune-Cookman's involvement in EOT-PACI's AN-MSI efforts began in November 2000, when the college's Director of Academic Computing participated in SC'00 as part of the first SC MSI Participation Project. Three Bethune-Cookman IT staff, including the CIO, had been participating in AN-MSI meetings sponsored by EDUCAUSE since the kickoff meeting in January 2000. It was at one of these AN-MSI meetings that the Director of Academic Computing heard about the SC MSI Participation Project and decided to enroll.

When Bethune-Cookman joined the AN-MSI project, its most pressing goal with regards to IT was to upgrade and standardize the college's network to ensure that all buildings had fast and consistent

network connections. The college was committed to improving its IT infrastructure, but it still had a long way to go before it reached the technical capacities of more traditional EOT-PACI partners like Clark-Atlanta or the University of Houston-Downtown. Through the EDUCAUSE portion of the AN-MSI project, Bethune-Cookman was able to upgrade its networks using the standards printed in AN-MSI's Network Model and was able to install a wireless network to provide connections for those buildings that were not yet wired. The CIO, Director of Academic Computing, and Director of Administrative Computing (the three most senior IT staff on campus) all participated in numerous AN-MSI meetings. The CIO and Director of Academic Computing were also members of AN-MSI Committees and participated as consultants in AN-MSI's Campus Action Team visits.

One of these three IT administrators became the "point-person" for Bethune-Cookman's explorations into high-performance computing via EOT-PACI. This administrator attended a total of six workshops and meetings related to EOT-PACI's AN-MSI efforts. In November of 2001, he attended SC'01 in Denver as part of the MSI Participation Project and then became part of the MSI HPC Working Group that grew out of the conversations at SC. The MSI HPC Working Group had its first meeting in March of 2002, and the Bethune-Cookman representative has been a regular participant ever since.

The same representative attended the second MSI Cluster Computing Workshop in April of 2002 with an engineering and computer science professor from Bethune-Cookman. This pair then used the knowledge they gained at the workshop to install Bethune-Cookman's first HPC cluster: a five-node cluster within the college's engineering department. The college is now in the process of expanding this to a 25-node cluster. In November of 2002, the same Bethune-Cookman representative went to SC'02 as part of the MSI Participation Project. The other two EOT-PACI events he attended were held on Bethune-Cookman's own campus, as described below.

After sending representatives to the EOT-PACI events mentioned above, Bethune-Cookman was committed to helping its faculty see the power of its new HPC resources and assisting them in finding the best ways to utilize them in teaching and research. To that end, they volunteered to host one of the modeling and visualization workshops given through the National Computational Science Institute (NCSI) in May of 2003. The NCSI workshops were developed by the Shodor Foundation, an EOT-PACI partner and co-developer of the MSI Cluster Computing Workshops, and it was through Shodor's presentations at the Cluster Workshops that many MSI participants were encouraged to enroll in the NCSI. The NCSI's week-long summer workshops provide intensive training for college instructors in HPC applications for science, math, and technology. Having one of these workshops at Bethune-Cookman provided a convenient opportunity for a significant number of its faculty attend. Thanks to that workshop and the previous interactions with EOT-PACI, Bethune-Cookman now has faculty members in engineering, computer science, chemistry, and physics involved in exploring HPC use in teaching or research.

Later that same summer, in July of 2003, Bethune-Cookman hosted a two-day workshop at which they and six other MSIs received Access Grid nodes and associated training from EOT-PACI. The college will be using its Access Grid node to connect to supercomputing resources online, adding to the HPC resources already available on campus, and will utilize the Grid's video-conference capabilities in the college's distance education program. Bethune-Cookman faculty who have started using HPC in their research can now collaborate over the Grid with computational scientists and educators across the country. When interviewed about the impact of EOT-PACI's AN-MSI efforts on Bethune-Cookman's campus, the representative who had been the most involved in EOT's AN-MSI activities had the following to say:

"I see EOT-PACI as a resource to help us as an institution to continue with the development of our [HPC] capacities and our knowledge base in regards to different types of applications that we can use. They provide us with lots of different resources and different contacts that we can call, because EOT-PACI has a lot of partners, and just by going through EOT-PACI we can get all that information. I look forward to working closely with them in regards to anything that we do in high performance computing…If it had not been for EOT-PACI and ANMSI introducing us to [high-performance computing], I don't think we would have had the opportunity to even get involved with it. So that has helped us tremendously, and we have benefited from that by attending workshops and getting a better understanding of what's involved."

<u>Winston-Salem State University (WSSU)</u>: Winston-Salem State, a mid-sized HBCU in Winston-Salem that is part of the University of North Carolina system, has become increasingly involved in technology-based collaborations and networks over the last few years. The CIO of Winston-Salem State has been an active participant in EDUCAUSE's AN-MSI meetings since April 2000. It was at one of these AN-MSI meetings in January of 2001 that she first became interested in supercomputing through a presentation given by EOT-PACI. She said in an interview in January 2002 that she was initially put off by what appeared to be "an elitist perspective in what [EOT representatives] were saying…that only those bigger schools like the ones from California and other places could be a part of it." Fortunately, this only made this CIO "more determined to be a part of it…The fact is, we can help them. They're not maximizing the use of that grid."

Because WSSU was not a school that EOT-PACI had worked with in the past, it was not, as one university representative put it, "on EOT-PACI's radar screen" until November 2001, when eight WSSU representatives participated in SC'01, including the CIO and six professors. Two of the professors already had some experience in using HPC, and all six expressed interest in using it in their teaching or research. From their survey and discussion group comments, it appeared that the most promising areas for development were in using HPC applications like Biology WorkBench and Sociology WorkBench to teach undergraduate research in the Biology Department and Social Science Department. These comments and possibilities were passed on to EOT-PACI by the evaluator, who included both WSSU and Bethune-Cookman in a report on four MSIs that appeared to have particularly fertile ground for HPC development.

The group of WSSU representatives that attended SC'01 was by far the largest contingent in that year's SC MSI Participation program, and the group came home from the conference inspired and more determined to become involved in HPC. As one WSSU faculty member said in an April 2002 interview, "The SC Conference was good in opening up my eyes—and [the CIO's] eyes—to the possibilities, and after that [the CIO] was a lot more supportive and invested in pursuing supercomputing at Winston-Salem." Once this interest was established, the campus moved ahead quickly. The North Carolina State system's regional technology committee was already having conversations about building a supercomputer center of its own, and, armed with the knowledge about HPC that she had gained through AN-MSI meetings, Winston-Salem's CIO was able to offer good advice on how to proceed. As the CIO explained in her January 2002 interview:

"What being a member of AN-MSI has done is give me clout with this regional technology committee that I'm on. We're dealing with Wake Forest and their Medical School, but from my having attended those AN-MSI meetings and listening to the EOT folks, I knew about Grid computing before they did. I understood the concept of Grid computing. And so when they were saying, "We want to set up a supercomputing center," I was the one who said, "No, we want to get on the Grid." And being a part of AN-MSI helped me be able to go back to the North Carolina Supercomputing Center and say, "Why can't

we be a part of that grid? And why can't we be in Internet 2 now?" And then I found out that the CIO at East Carolina wanted to be a part of the grid, too. He didn't know about this stuff yet, so he hadn't been able to get going on it. What I value most about EOT and AN-MSI is the clout that it has given me. And the education …What AN-MSI is doing is giving me a national platform to understand all these issues."

Taking the lead in the region's exploration of HPC, WSSU held its own state-wide supercomputing conference in January 2002, where faculty and IT staff from around North Carolina and the region came to learn about the possibilities and explore the costs. WSSU already had a gigabit network at that point and was in the process of setting up a computing cluster in its new Computer Science Center (due to be completed in 2003), establishing a high-speed Internet 2 network with other small institutions and businesses in its region (North Carolina Research and Education Network-3, or NCREN-3), and buying processing time and a high-speed link at the North Carolina Supercomputing Center. All of these projects have moved forward with full support from WSSU and the UNC system.

Of course, infrastructure development is only part of what is needed to make high-performance computing possible. Developing the interest and technical abilities of faculty and staff is also critical if the HPC equipment is to be fully utilized, and the CIO's background in faculty development made her a strong proponent for getting faculty involved from the start, both in attending the SC Conference and in attending and developing WSSU's supercomputing conference. Two of the faculty members who had attended SC'01 went on to attend the first MSI Cluster Computing Workshop in March 2002, because, as one of these faculty members explained in an interview a month later:

> "A lot of what I saw at SC was over my head. There wasn't a lot there for someone with limited background in HPC, because everyone assumed that you were already well-versed in it. But the EOT events were very good in terms of creating a way for people to network and find people at other MSIs to collaborate with…What the conference showed me is that I didn't have a very good understanding of what HPC really involved from a technical standpoint, so that is what motivated me to sign up for the Cluster Workshop in San Diego."

This WSSU faculty member and another who attended the cluster workshop in Sand Diego rated the event highly on their post-workshop surveys. Gaining more expertise in cluster computing allowed the faculty and staff at WSSU to consider how to expand their HPC capacities right on campus without having to depend on other institutions or distant supercomputer centers. Later that Spring, EOT-PACI provided WSSU with a "Cluster in a Box" 4-PC cluster of their own because of their high level of faculty participation in EOT-PACI events. This cluster was installed and is already in use by some WSSU faculty who gained training in HPC applications through NCSI modeling and visualization workshops offered by the Shodor Foundation. In the meantime, three WSSU faculty members, including the two who had attended the first Cluster Workshop, became members of the MSI HPC Working Group, which had its first meeting in March 2002. The member of this group that had not attended the first Cluster Workshop attended the second one in Urbana in May 2002, along with WSSU's curriculum designer. Several WSSU representatives attended modeling and visualization workshops over the summer of 2002, and four of these faculty then attended the third Cluster Workshop in Atlanta in September 2002. Five WSSU representatives including the CIO attended SC'02 in Baltimore, where the tutorials that were part of the Education Program were of particular interest, and the two faculty who are members of the MSI HPC Working Group attended the EOT-PACI NSF Proposal Writing Workshop in March 2003. The combined impact of all of these EOT-PACI AN-MSI events and WSSU's high level of participation in them has been to turn

Winston-Salem State into a leader in HPC development at mid-sized MSIs and within the UNC system.

5.3. EOT-PACI's impacts on small MSIs with relatively few resources to devote to IT:

Among the nine MSI representatives interviewed for the EOT-PACI evaluation, the ones who were the most ambivalent about the relevance of HPC technology to their own schools were the two interviewees from small, rural Tribal Colleges. On the one hand, the interviewees from the Tribal schools could see the benefit of the Access Grid in distance education courses, and one of these schools is already working on setting up an HPC cluster using older PCs at his school. On the other hand, neither school currently has the staff, faculty, or student expertise to fully utilize HPC resources, and both interviewees said that none of the applications they have been shown so far seem relevant to their current undergraduate curriculum. Another interviewee at a small HSI also seemed uncertain about exactly how HPC could be used at his school, but he expressed interest in exploring the possibilities because he feels it is essential for students to gain experience with high-end technology. This HSI faculty member is now part of the MSI HPC Working Group. Of the thirteen schools currently participating in the Working Group, seven are HBCUs, three are HSIs, and three are TCUs.

One TCU representative has worked with EOT-PACI to give them more perspective on the needs of smaller, poorer schools. This Tribal technology specialist gave presentations at the last two Cluster Workshops on his own attempts to find a place for HPC at his school and on some of the obstacles he has encountered. When asked in April 2002 about what EOT-PACI could do to help advance HPC usage at small MSIs like his own, this Tribal representative said:

> "Having gone to the cluster workshop in San Diego for me was great because I could see what other colleges are doing and relate it back to what I'm seeing going on here. But a rural Tribal College like mine is just in a different universe. How I can adapt that [HPC stuff] to here, that's another thing entirely. The best thing I've got as far as a comment is: I think all the stuff that they are doing is marvelous, is wonderful. Keep it up. How it can help the minority colleges like mine, I don't know. I haven't figured that out yet."

6. Conclusion:

Since its creation through an NSF grant in October 1997, one of EOT-PACI's primary goals has been to increase the representation of women and ethnic minorities in computational science. EOT-PACI's goal within the AN-MSI project, initiated in September 1999 through an NSF grant awarded to EDUCAUSE, was to assist Minority-Serving Institutions in developing the computational infrastructure and skills necessary to utilize high-performance computer applications and resources.

In the four years of the AN-MSI project, EOT-PACI has sponsored 156 individuals representing a total of 23 HBCUs, 17 HSIs, 13 TCUs, and 3 minority-serving technology organizations to attend numerous EOT-PACI workshops and national conferences like SC. Through the SC MSI Participation Program, EOT-PACI has substantially increased the number of minorities and MSI representatives attending the nation's premier supercomputing conference and has created an ongoing community of MSI faculty and staff invested in HPC education and research. Through its MSI Cluster Computing Workshops, EOT-PACI has given 55 MSI representatives high-quality, hands-on training in setting up and using PC clusters to run HPC applications. The participants have used this information and donations of PC clusters from EOT-PACI to set up clusters at their own

institutions, several of which are being utilized for both education and research. EOT-PACI has funneled dozens of MSI faculty members into the NCSI modeling and visualization workshops run by the Shodor Foundation, where they receive a week's worth of training in how to integrate HPC applications in science and math into their teaching. In addition, EOT-PACI has provided seven MSIs with their own Access Grid nodes and the training in how to use them, connecting these schools via a high-capacity grid to supercomputer centers and majority institutions nationwide. Ten representatives of the seven MSIs that have participated in these various workshops and projects have formed an ongoing MSI HPC Working Group that looks for opportunities and funding for MSIs to engage in collaborative HPC projects.

A two-year evaluation of EOT-PACI's AN-MSI efforts has shown all of their evaluated workshops to be of high quality and relevance to MSIs. The long-term impact of these various workshops and activities on the 54 institutions that have participated in them has varied. In general, MSIs that were at a mid-level of technical development but still interested in exploring HPC showed greater long-term impacts from EOT's activities than the most technically-advanced MSIs or small MSIs with very small IT budgets. For example, MSIs like Bethune-Cookman College and Winston-Salem State University have seen tremendous gains in their technological capacity and their faculty and staff preparedness through both the EDUCAUSE and the EOT-PACI portions of the AN-MSI project. These schools and others involved in EOT-PACI's AN-MSI efforts have leveraged their connections to EOT-PACI to receive technology-related grants from federal organizations and private foundations, the ultimate impacts of which will not be known for several more years.

The LEAD Center's evaluation suggests that EOT-PACI has made substantial progress in the first two of its supporting goals within the AN-MSI project: showing MSI representatives the possibilities of HPC technology and including substantive numbers of MSIs in HPC conferences in which they have had little representation in the past. EOT-PACI's final goal of helping to develop collaborations between computational scientists at MSIs and their peers at majority institutions and research centers was addressed within the SC MSI Participation Project; however, whether the networking done at the SC conference will result in actual collaborations on grants and research projects remains to be seen. Those MSI representatives who have participated in EOT-PACI's AN-MSI efforts have gained a great deal from them as individuals, and at least a dozen of their institutions have gained substantial benefits as well, from free HPC equipment to extensive training of faculty and staff in HPC applications. The future task of EOT-PACI is to continue to provide a forum for HPC-focused collaboration within the MSI community, but also to facilitate stronger connections between these MSI faculty and their counterparts at major research institutions.