I. Introduction and Rationale

The three organizations that comprise the Alliance for Equity in Higher Education -- the American Indian Higher Education Consortium (AIHEC), the Hispanic Association of Colleges and Universities (HACU), and the National Association for Equal Opportunity in Higher Education (NAFEO) -- propose to establish the Minority-Serving Institutions (MSI) Cyberinfrastructure (CI) Institute [MSI C(I)^2] that will foster a CI-enabled distributed research and education network providing e-science education and research opportunities to MSI faculty and students. For overviews of Cyberinfrastructure and Grid computing, see (Foster and Kesselman, 2003; Berman, Fox, and Hey, 2003). The Institute will provide "human middleware" – the communication and support linkage - between MSI faculty and students, and researchers associated with e-science and CI initiatives. Specifically, the project will provide:

- three planning sessions with acknowledged leaders in the e-science/cyberinfrastructure community;
- a cyberinfrastructure/e-science training series for MSI faculty consisting of three 2-day sessions at the Global Grid Forum, SuperComputing 05, and the San Diego Supercomputing Center;
- a five-day residential training program;
- e-science research projects involving teams of MSI participants and leaders in the e-science community;
- a portal for accessing Grid resources and providing a collaborative environment that will support CI Institute training, research, and mentoring functions;
- a variety of opportunities for MSI faculty to join a growing network of e-science and cyberinfrastructure practitioners at major e-Science/cyberinfrastructure events

Through the MSI CI Institute, a distributed community of researchers, faculty, and students will participate collaboratively to provide training and support in developing CI skills among MSI faculty and staff, develop and pilot new CI tools that support the distributed research and education process, and plan and implement specific research and education projects. This community brings together identified leaders involved in the development of CI tools and applications, faculty and researchers associated with major CI programs, and the faculty, students and technical staff at Minority Serving Institutions. The project will use the "training the trainers" model, in which MSI faculty are trained to prepare and support their colleagues as they develop the expertise necessary to exploit CI to support STEM research and education at their home institutions.

This demonstration project will show proof of concept for a scalable mechanism designed to significantly impact the development of CI-related science and engineering workforce and to broaden access, participation, and appreciation for CI and e-science, particularly among traditionally underrepresented minority populations. It will do so by establishing a dynamic community of learning and practice starting with a pilot group of domain science research faculty and students as well as computer scientists and technical staff at Minority-Serving Institutions, and leading faculty researchers at major research institutions involved in e-science.

Dr. Julie Foertsch of the UW-Madison's Learning through Evaluation, Adaptation, and Dissemination (LEAD) Center will be serving as the external evaluation consultant for this project. The evaluation of all aspects of this pilot will provide the basis for a plan for scaling up the project (see Evaluation Plan, p15).

I.1 *Intellectual Merit*

Native Americans, African Americans and Hispanics perniciously persist in being underrepresented in the sciences even as their numbers and proportion in higher education grow (National Science Board (NSB), 2004), and science evolves with cyberinfrastructure providing a greater opportunity for more to participate (Atkins, et al, 2003). Since Minority-Serving Institutions disproportionately produce science and engineering graduates (NSB, 2004; NSF, 2004) and enroll underrepresented minorities, MSIs must be brought into the cyberinfrastructure community in a meaningful way, as noted by the Atkins report (Atkins, et al, 2003) and the PITAC (1999). Through a novel collaboration of MSIs and key leaders in cyberinfrastructure, the proposed project provides a proof of concept for a mechanism to build the cyberinfrastructure and e-science knowledge and skills of MSI faculty. Thus fostering the inclusion of MSIs and the students they serve into the growing national cyberinfrastructure activities, and prepare the current and next-generation scientists at MSIs to use, support, deploy, develop or design cyberinfrastructure. It provides the basis for a scalable, national initiative, and the cornerstone for building the needed human "middleware" to build cyberinfrastruture-enabled MSI and research I university collaborations in e-science. The project will advance the knowledge associated with building multi-institutional and cross ethnic research and educational collaborations (Cummings & Kiesler, in press) critical for cyberinfrastructure development. It will establish the basis for collaboration and community-building through both education and project-based mentoring of faculty and students.

The principal investigator is Geoffrey Fox at Indiana University, pioneer in grid computing and Visiting Scholar for Cyberinfrastructure Development to the Alliance; Karl Barnes, Director of Technology at the National Association for Equal Opportunity in Higher Education, Carrie Billy, Director of Technology and Operations at the American Indian Higher Education Consortium, and Alexander Ramírez, Executive Director for Information Technology Initiatives, Hispanic Association of Colleges and Universities, and Richard Aló, Director of the Center for Computational Science and Advanced Digital Simulations at the University of Houston Downtown will serve as co-principal investigators. Jamie Merisiotis, Executive Director of the Institute for Higher Education Policy, will serve as project manager. Marlon Peirce, Community Grids Lab, Indiana University will direct development of the MSI CI Institute Portal, under the supervision of the PI.

The advisory/strategic planning group will include Fran Berman, Director, San Diego Supercomputer Center (SDSC), University of California, San Diego, and PI on the NSF TeraGrid; Dan Reed, Director, Renaissance Computing Institute, University of North Carolina-Chapel Hill, and former Director of the National Center for Supercomputer Applications (NCSA); Mark Ellisman, Director, Biomedical Informatics Research Network (BIRN), University of California, San Diego; Kelvin Droegemeier, Linked Environments for Atmospheric Discovery (LEAD), Oklahoma University; Ian Foster, University of Chicago, and Associate Division Director, Distributed Systems Lab, Mathematics & Computer Science,

Argonne National Laboratory; and Dan Atkins, University of Michigan, Chair of the NSF Blue Ribbon Panel on Cyberinfrastructure, Executive Director, Alliance for Community Computing; bringing irreplaceable cyberinfrastructure and e-science expertise to the project.

I.2 *Broader Impacts*
The proposal establishes the basis for a scalable engagement of MSIs that, when fully implemented, fosters the integration of cyberinfrastructure/e-Science into educational fabric of MSI's. It is designed to develop the MSI capacity to prepare underrepresented minority students for a future in cyberinfrastructure-facilitated science and the knowledge-based economy, and to provide an opportunity to join the next generation of the professoriate. This is critical for the nation's future STEM workforce in the knowledge-based economy and the nation's leadership in science and engineering (NSB, 2003).   Through the Alliance for Equity in Higher Education and the three member organizations (the Hispanic Association of Colleges and Universities, the National Association for Equal Opportunity in Higher Education, and the American Indian Higher Education Consortium), at least 335 Minority Serving Institutions could be affected under full implementation of the Institute that could meaningfully engage the entire MSI community.

The Alliance for Equity in Higher Education provides a broadly systemic approach to reaching underrepresented minority students and engaging this nation's American Indian Tribal Colleges and Universities, Hispanic-serving Institutions, and Historically and Predominately Black Institutions in the exploration, dissemination and adoption of cyberinfrastructure tools, services and initiatives supporting research and education. The three organizations that comprise the Alliance and will lead this project – the American Indian Higher Education Consortium (AIHEC), the Hispanic Association of Colleges and Universities (HACU), and the National Association for Equal Opportunity in Higher Education (NAFEO) -- represent the broadest coalition of minority serving institutions in American higher education. Engaging MSIs is an efficient way of reaching the growing number of underrepresented minority college students, the next generation of scientists and engineers. Although only a relative small percentage of colleges and universities in the country, MSIs serve a much greater proportion of underrepresented minority students, e.g., HSIs are only about 6% of the higher education institutions in the country, but produce a third, 33%, of Hispanic science baccalaureates, and HBCUs produce the same percentage for African Americans (National Science Board, 2004).   AIHEC and HACU are the only national associations representing TCUs and HSIs, respectively, and NAFEO has served as an advocate for historically and predominately black colleges and universities since 1969. Additionally, the Alliance is able to attract notable national experts in cyberinfrastructure and e-science to work with its membership to plan, design and implement an effective institute, and broaden participation and impact of cyberinfrastructure on society and the next generation of scientists and engineers.

I.3 *Relationship of objectives to long-term goals of the Alliance and to work-in-progress*
The Alliance for Equity in Higher Education has served as a model of community-owned collaboration among the three MSI communities since it was established in 1999. The Alliance is a mechanism for several important joint initiatives among the three partner organizations, including an NSF funded project to disseminate the innovative outcomes of the

Minority Institutions of Excellence (MIE) program and a four-year, $6 million project funded by the W.K. Kellogg Foundation to train the next generation of MSI presidents. The Alliance has emphasized the challenges of technology as one of its two major policy priorities (the other being student performance) over the next several years. A recent policy report from the Alliance focused on the results of a survey of MSIs concerning technology at MSIs and the potential "leapfrogging" in capacities that could take place at these institutions with appropriate investments in academic and administrative technology applications (Alliance for Equity in Higher Education, 2004). Each of the three organizations comprising the Alliance, AIHEC, HACU and NAFEO is currently implementing technology initiatives and programs under the direction of three of the proposed project's co-PIs.

I.4 *Building on the AN-MSI Project*

The MSI C(I)[2] will build upon the collaborative community of MSIs established over the last five years by this group and EDUCAUSE through the Advanced-Networking with Minority-Serving Institution (AN-MSI) project, (Artze, 2002; Davis & Trebian, 2001; Foertsch, 2003, 2004; Foster, 2003; Olsen, 2002; Ramirez, 2004; Ramirez, Davis, Harris & Staudt, 2001). The AN-MSI initiative was established in 1999 to assist MSIs in developing the campus infrastructure and trained support staff necessary for achieving full participation in the Internet-based Information Age. In its first four years, the project brought together 101 MSIs representing three disparate communities. The project identified five key strategic goals (generally adhered to here) of: 1) Collaboration: maintain and enhance a collaborative environment that facilitates inter-institutional research and education activities; 2) IT Leadership: Develop current and future minority IT leadership (including developing the IT awareness of presidents and other institutional executives); 3) Infrastructure: Assist MSIs in assessing, understanding and improving the networking and communications technologies at their institutions; 4) Applications: Assist participating institutions in applying technologies to research and education; and 5) IT Support: disseminate proven IT support strategies to participating institutions. The evaluation cited collaboration and community-building as the key strengths of this group (Foertsch, 2004).

II. VISION, MISSION AND GOALS

Vision: To prepare the current and next generation of traditionally underrepresented minority scientists, engineers, and educators with the knowledge and skills necessary to conduct e-science and use, support, deploy, develop, and design CI.

Mission: Build and enhance meaningful collaborations between MSIs and the nation's CI initiatives to ensure that necessary resources are available to develop and support their faculty and technical staff to become members of the national e-science community of practice.

II.2 GOALS AND OBJECTIVES

GOAL 1. Develop the MSI Faculty and Technical Staff CI and e-Science training and support program: *Conduct "train-the-trainer" and strategic planning sessions with CI and MSI leaders to identify Institute priorities and develop demonstration project curriculum*

Objective 1.1 Develop initial "train-the-trainer" curriculum and recruit an initial cohort of 6 MSI science faculty or technical staff with strong research or teaching backgrounds;

Objective 1.2 Conduct three "train-the-trainer" sessions combined with strategic planning meetings including CI and MSI leaders to identify Institute priorities and develop demonstration project curriculum

Objective 1.3 Identify and collect existing CI training and support resources and materials;

Objective 1.4 Develop curriculum and courses for 1-week residential CI Institute for MSI faculty based on outcomes of planning forum;

Objective 1.5 Develop a library of CI resources accessible through the web portal.

GOAL 2. Build an MSI e-Science Community: *Recruit and prepare pilot MSI faculty cohort and e-science leaders to participate in e-science research and education activities*

Objective 2.1 Conduct three initial training sessions for MSI faculty leaders at grid computing/e-science events

Objective 2.2 Offer the CI Institute residential program to an initial faculty cohort;

Objective 2.3 Identify an e-science research collaborator/mentor to work with the cohort members;

Objective 2.4 Identify Research Practicum projects for interdisciplinary teams;

Objective 2.5 Provide support to faculty and IT staff at participating institutions as they implement their e-science projects.

GOAL 3. Establish the MSI CI Institute Portal: *The CI Institute web portal will support training and support of distributed research and education activities at participating institutions*

Objective 3.1 Recruit web portal development team including faculty and staff that will provide an advisory function to collaboratory web portal design and development activities;

Objective 3.2 Develop and deploy the CI Institute collaboratory web portal which will provide logistical, training and support resources to participating MSI faculty on e-science topics such as remote instrumentation, biological data repositories, and computation resources;

Objective 3.3 Modify web portal functions in response to recommendations from participants, and as new open source services are made available by the grid computing community

III. Plan of Work

The three main components of the MSI CI Institute -- the residential program, the research and development practicum, and the portal -- will be developed in a coordinated manner using the strategic planning and faculty training sessions as a source of input from both target MSI faculty and e-science practitioners.

III.1 Developing the Institute

a. Strategic Planning
Strategic planning will be accomplished through a combination of face-to-face meetings and virtual meetings using tools such as the ACCESS Grid. The primary goal of the strategic planning will be to identify and develop strategies for using both national CI and MSI resources in a way that maximizes the number of MSI faculty who are positively affected by the project, particularly as the project is scaled up.

The planning team members will include the Advisory Group, the Project Management Team and the six faculty leaders from the MSI community participating in the first "training the trainers" cohort (described below).

The group will meet (in-person and virtually) in three strategic planning sessions: during the October Global Grid Forum conference in Boston, the Supercomputing 2005 conference in Seattle in November 14th, and at the San Diego Supercomputing Center in early 2006. The MSI faculty and advisory group members unable to attend in-person will participate remotely through the Access Grid or teleconferencing. The objectives of the initial planning session will be to:
- outline the CI Institute curriculum
- finalize the design objectives for the MSI CI web portal
- identify outreach resources at existing CI sites that can be made available to the project

During the second and third strategic planning sessions the Principal Investigator (PI) will provide a progress report, and will distribute a draft description of the training curriculum for review by the planning team. In addition to review of specific project activities and outcomes, a major focus for these subsequent sessions will be on developing the sustainability and scaling up plans for the Institute. The project team members will develop and disseminate a report with recommendations from each meeting.

b. The e-Science Forum Series: Training the Trainers
The basic model for the MSI CI Institute will be "Training the Trainers," intended to maximize the impact of limited training resources by preparing MSI faculty to support their colleagues as they enter the CI-enabled e-science community. They will be prepared to provide introductory training to their MSI colleagues, both at their home institutions and during the summer residential program, in collaboration with e-Science trainers identified through the expert Advisory Board. They will receive additional in-depth training during the summer residential program. Six (6) MSI faculty members will be recruited for this pilot implementation.

Three two-day "Train-the-Trainers" sessions will be conducted during the course of the project, coordinated with the strategic planning sessions described above. The PI will be the primary trainer; additional trainers will be recruited from the advisory/strategic planning group.

The first session will take place at the Grid Global Forum (GGF) in the fall of 2005, the second at Supercomputing (SC05), and the final session at the San Diego Supercomputer

Center (SDSC) in the late winter/early spring 2006. Coordinating the training with national grid/e-science events will provide an opportunity to introduce the participants to the wider community of grid computing and CI researchers and developers.

Recruitment of the first MSI faculty cohort will be carried out by AIHEC, HACU, and NAFEO members of the project team, and will place highest priority on faculty with a strong research background and interest in entering into CI-mediated research collaborations. Each of the participating organizations will identify two faculty members to participate as members of the cohort. These faculty participants will represent the initial group of trainers in the "training the trainers" cycle.

c. The Residential Program
The five-day residential program will be designed to offer a combination of presentations by e-science practitioners, hands-on work with e-science tools, seminars, and group projects. The Institute will provide the opportunity to explore and investigate the science research and education opportunities emerging from the rapidly evolving e-science research environment. It will be intended to provide both the skills and the motivation necessary to continue participating in both the Institute and e-science after the participants return to their home institutions.

The residential program will be designed to provide two professional development tracks, one for domain science faculty, and one for computer science faculty and staff. The domain science faculty track will focus on first providing participants an introduction to e-scientific tools and methods, then supporting them as they apply these tools and methods to research problems. They will be given access through customized portals to operational science grids allowing modern science to be incorporated into research and education at MSI's. The computer science track will provide both computer science faculty and IT technical staff an introduction on the design and development of e-science tools and services. They will see these tools in action through portals to science grids including access to such operational Grids as TeraGrid and to the Grid Operation Centers managing Grid services, and will participate on development teams in designing services customized for the needs of MSI faculty and students.

A core Institute curriculum will be developed by the trainers, primarily by adapting materials already developed through e.g. the International Summer School on GRID Computing, the Department of Defense's Program Environment and Training,the National E-Science Centre, and the San Diego Supercomputing Center. Examples of material are available from (Carpenter, Fox & Pierce, 2004; Fox & Pierce, 2004; Fox & Pierce, 2005).

The curriculum will provide base level e-science skills. However, the specific offerings of a given residential program will vary, based on the needs and interests of the participant group, and especially on the distribution of represented disciplines. In general, all participants will be expected to achieve a basic level of competence in the following topics during the course of the project:
i) Domain science faculty learning objectives
- Basics of advanced scientific computing methods

- Using Grids to do remote processing
- Data mining and management
- Collaborative scientific research using CI
- Visualization
- Using remote instrumentation
- Pedagogies for teaching and learning of domain science using CI

ii) Computer and information technology faculty and staff learning objectives
- Basic Java-based Web service technology
- Developing grid service components with Java technology
- Grid architecture
- Collaborative grids
- HPC application engineering
- Grid-enabled databases
- Security issues
- Leadership and support for the introduction and engagement of faculty and entire campuses with CI and e-science

The project team will work with the strategic planning group to identify specific learning objectives within each of the topics listed above. These learning objectives will be translated into the lecture and laboratory sessions of the residential program. Since the residential program is only five-days in duration, the priority will be on providing faculty entry-level skills that can be built upon through year-long participation in the research and development practica.

III.2 Conducting the pilot residential MSI CI Institute

a. Recruitment of the first cohort of residential program participants
The first cohort for the residential program will consist of four faculty members from each MSI community for a total of twelve, including the six previously trained peer trainers. Participants will be selected by the members of the strategic planning group (the advisory group, the project team, and the first "training the trainers" faculty team. Participation will be open to all science and engineering disciplines, but where and when possible disciplinary themes will be derived from the application pool, as well as, particular disciplines may be emphasized in the call for participation, so as to build a more disciplinary homogeneous cohort.

b. Recruitment of Mentors/Research Collaborators
The project will provide a brokering function between national and international e-science programs, their researchers and faculty and MSI faculty. The e-science initiatives represented by the members of the Advisory Group will provide a primary source for the mentor pool. A directory of e-science practitioners will be developed and categorized according to discipline, specialization, and specific research instrumentation and methodologies used. Each participant (or team of participants in the same discipline) will be paired with an appropriate research or development mentor/research collaborator associated with an existing e-

science/CI program. The mentors/research collaborator will provide the participants support as they design and implement their e-science projects.

c. The training facility
The residential program will be hosted by one of the major e-science initiatives listed below. Training material developed specifically for the Grid projects will be adapted for the residential training.

> iSERVO: Geosciences; http://servo.jpl.nasa.gov/ Indiana University
> iVDGL: physics and astronomy; http://www.ivdgl.org/ University of Chicago
> LEAD: atmospheric sciences; http://lead.ou.edu/ University of Oklahoma
> BIRN: biomedicine; http://www.nbirn.net/ University of California San Diego
> TeraGrid: computer science; http://www.teragrid.org/ San Diego Supercomputing Center

The location for the residential program will be determined on the basis of the disciplines represented by the cohort of faculty/staff participants recruited. Program staff with assistance from the oversight committee will arrange disciplinary scientists, engineers or technical staff to be faculty for the Institute varying on an annual basis dependent upon derived disciplinary or CI themes.

Resources from other major e-science initiatives such as the National Science Digital Library and the National Virtual Observatory will be utilized by the CI Institute as appropriate. We will also include programs involving advanced ideas such as the opticomputer being developed by Larry Smarr at the California Institute for Telecommunications and Information Technology, Cal-(IT)^2.

d. Research and Development Practica

Each CI Institute residential program participant will be required to complete a practicum from one of the following categories. To the extent feasible, participants will be encouraged to form multidisciplinary teams.

Research
Each science faculty participant will be required to complete a small project involving use of remote instrumentation and/or datasets. The project will require a level of proficiency on the part of the faculty member in each of the relevant learning objectives for the Institute. During the residential program, participants will have opportunities to refine and develop their proposed research practicum projects in consultation with the Institute training team and their assigned mentors/research collaborators.

Development
Computer science faculty and IT staff participants will be required to participate as a team in a specific develop project, e.g. developing a component of a grid tool or service. Project ideas will be identified during the residential program.

Education

A faculty member choosing to work on an education project will create a course, course module, or set of learning objects appropriate for inclusion in an undergraduate domain or computer science course.

The mentors will work with their assigned faculty participants to identify an appropriate e-science research practicum project. The project will be designed to maximize the faculty participant's experience with all aspects of e-science research. The project team will provide technical support to each faculty participant as they carry out their respective research projects. Monthly teleconferences will be conducted with the entire faculty cohort to discuss progress on research projects, support issues.

III.3 Establishing the MSI CI Institute Portal

Indiana University's Community Grids Lab will take the lead in the development of the initial MSI Institute Grid Portal. The planning team, as well as MSI faculty recruited to participate in the first Institute cohort will provide an advisory function to collaboratory portal design and development activities, using the participatory design model. Portal design will exploit existing collaborations with the Open Grid Computing Environments (OGCE, 2005) project, an NSF National Middleware Initiative-funded effort, as well as other members of Grid portal community including OGCE users, uPortal (uPortal, 2005), Sakai (Sakai, 2005), and GridSphere (GridSphere, 2005) projects.

The work in this project will involve no new grid technologies, but rather it will make use of existing capabilities from projects mentioned above, for which we will develop culturally sensitive user interfaces and customize existing tools to reflect the particular resources (computers, databases, etc) needed by the MSI community.

The portal will provide access to Grid resources that support teaching and learning; lesson plans with online documentation, digital material, multimedia records, and a collaborative environment that will support the entire community of learning and practice involved with the CI Institute. It will promote close coordination and management of relationships with the entire e-science community. Mentors from the collaborating institutions will be available on-line to support faculty, staff and students. The portal will also provide a laboratory for grid services projects. The portal will allow users to run code, manipulate data and files, and access components of the computational grid through a web interface that will be designed by the project participants.

Collaboratory tools will include traditional functions such as chat, email, audio/visual conferencing, shared whiteboards, electronic calendars, threaded discussion boards, decentralized file distribution, data warehousing, instant messaging, distributed publishing, and distributed applications. Several of these are already available through the OGCE consortium. Real-time/asynchronous approaches will be used to facilitate discussions and data/application sharing involving access node technologies.

III.4 Timeline

Goal/ Obj.	Activity	Tasks	1	2	3	4	5	6	7	8	9	10	11	12	Persons Responsible
1	Convene advisory/ planning team	Hold first meeting during Global Grid Forum in Boston October 3-6	x												Principal Investigator; Management Team
		Hold second meeting during SuperComputing 2005		x											
		Hold third meeting at San Diego Supercomputing Center					x								
		Develop and disseminate report and recommendations						x							
1,2	Implement "Train-the-Trainer" sessions	Develop preliminary training curriculum	x												Principal Investigator; Management Team
		Recruit first "training the trainers" cohort	x	x											
		Conduct first training during Global Grid Forum Oct 4	x												
		Conduct second training during Supercomputing 2005		x											
		Conduct third training at SDSC					x								
3	Establish prototype grid portal	Identify existing grid portal for template	x	x	x										Principal Investigator; IU Community Grids Laboratory staff
		Deploy and evaluate portal and identify services required for MSI e-science portal		x	x	x	x	x	x	x	x	x	x	x	
		Provide support to all participants in accessing portal services			x	x	x	x	x	x	x	x	x	x	
3	Adapt/modify portal as required	Recruit teams for specific MSI E-Science services	x	x	x	x	x	x	x	x	x	x	x	x	Principal Investigator; IU
		Develop/adapt required portlets/services	x	x	x	x	x	x	x	x	x	x	x	x	
2	Develop residential training curriculum	Develop training curriculum outline based on planning, "train the trainers" sessions	x	x	x										Principal Investigator, consultants
		Create/collect curriculum materials for the residential training	x	x	x	x	x								
		Distribute course descriptions and curriculum materials to planning team for review			x	x	x								
2	Conduct residential institute	Recruit faculty cohort, trainers	x	x	x	x	x	x							Principal Investigator; trainers
		Schedule e-science facility					x	x							
		Conduct Institute									x				
2	Implement practicum	Identify appropriate e-science mentor for each participant				x	x	x	x						Principal Investigator, participants; mentors
		Provide ongoing support as participants plan and implement their projects									x	x	x	x	
		Conduct monthly teleconference with entire faculty cohort									x	x	x	x	
2	Formative and summative evaluation	Collect evaluation data	x	x		x	x	x	x	x	x	x	x	x	external evaluator
		Develop formative evaluation report				x	x	x	x	x	x	x	x	x	
		Develop summative evaluation report											x	x	
1,2	Develop growth plan for scaling up the project based on the evaluation outcomes and planning meetings	Circulate formative evaluation and progress reports										x	x		Principal Investigator; Management Team; Advisory Group
		Conduct teleconference discussion with advisory group and Management Team to discuss basic components of growth plan												x	
		Disseminate plan to all project participants for review and recommendations											x	x	

IV. Collaboration Plan
Organizations: Hispanic Association of Colleges and Universities,(HACU), National Association for Equal Opportunity in Higher Education (NAFEO), the American Indian Higher Education Consortium (AIHEC), the Institute for Higher Education Policy (IHEP).
Institutions: Indiana University, University of Houston – Downtown, University of Michigan, Oklahoma University, University of Chicago, Argonne National Laboratory, University of California, San Diego, University of North Carolina –Chapel Hill.
*e-Science Initiative*s: iSERVO, iVDGL, LEAD, BIRN, TeraGrid, the Global Grid Forum, the National Science Digital Library, the National Virtual Observatory.

The Alliance for Equity in Higher Education, composed of AIHEC, HACU, and NAFEO, national MSI membership organizations, represents the minority serving institutions. They will mobilize the MSI community, raise the awareness of MSI presidents and other key executives, recruit faculty participants, disseminate outcomes and lessons learned to the MSI and e-science community, and ensure that the project's outreach efforts are effective in identifying participants that are prepared to help bring e-science and CI educational and research opportunities to their home institutions and help to engage the MSI community.

The member organizations of the Alliance will work with leading scientists and developers in cyberinfrastructure and e-science to participate in identifying the best strategies for developing and using the MSI Cyberinfrastructure Institute as a vehicle for engaging a significant number of MSI faculty and students in cyberinfrastructure research and development activities. As mentioned in the introduction, this group will include such recognized leaders as Fran Berman, Director, San Diego Supercomputer Center (SDSC), University of California, San Diego, and PI on the NSF TeraGrid; Dan Reed, Director, Renaissance Computing Institute, University of North Carolina-Chapel Hill, and former Director of the National Center for Supercomputer Applications (NCSA); Mark Ellisman, Director, Biomedical Informatics Research Network (BIRN), University of California, San Diego; Kelvin Droegemeier, Linked Environments for Atmospheric Discovery (LEAD), Oklahoma University; Ian Foster, University of Chicago, and Associate Division Director, Distributed Systems Lab, Mathematics & Computer Science, Argonne National Laboratory; Geoffrey Fox (PI), Indiana University, pioneer in grid computing and Visiting Scholar for Cyberinfrastructure Development to the Alliance; and Dan Atkins, University of Michigan, Chair of the NSF Blue Ribbon Panel on Cyberinfrastructure, Executive Director, Alliance for Community Computing.

Researchers and outreach specialists from the listed e-science initiatives will provide access and CI resources and research opportunities for Institute participants at their respective sites. These sites will also provide additional guidance in articulating the e-science training experience with the research and technical skills necessary for becoming a strong partner on a distributed e-science research team.

V. Scaling up the MSI CI Institute
While the details of the plan to scale up the Institute will depend on the outcomes of the formative and summative evaluations and Advisory Board expert recommendations, in

general terms it will involve increasing the size of the faculty member training cohorts and the number of MSIs participating, the type of training to be offered, and adding domain science fields and cyberinfrastructure initiatives. In addition, the role of the MSI Cyberinfrastructure Institute portal will be expanded to provide additional training and support resources as the project expands.

The longer term goal for this project is to have at least one faculty member from at least 80% of the institutions associated with the Alliance participate in a Cyberinfrastructure Institute training activity, either through a conference-related workshop, the summer residential training, a regional MSI workshop online or other activities offered. With a total combined institutional membership of 335, this means a target of 302 faculty members and institutions. Under full implementation, we project possibly training 120 faculty members per year over 3 years across a variety of e-science domains using a variety of cyberinfrastructure resources. This could provide a basis for further penetration beyond one faculty member per campus.

Ultimately we envision having e-Science program activities established at all member institutions, supported by a network of mentors, trainers and technical support staff facilitated through the MSI Cyberinfrastructure Institute. This will be facilitated by successfully transitioning faculty training participants into e-science research and education activities through the year-long practicums. The implementation of this Institute component will receive special focus in the formative and summative evaluations to identify effective strategies for successful transition to participation in e-science research and cyberinfrastructure development.

MSI CI Institute revenue
The project team will pursue private sector sponsorships from foundations and corporations, as well as an at-cost fee schedule for CI Institute participants.

Research Experiences for Undergraduates
As a component of the scaling up plan, the project team will develop an undergraduate research seminar in which a portion of the training curriculum from the residential program is adapted for undergraduates as a foundation for their participation as research assistants on e-science research projects. Eventually, student may be invited to accompany faculty members at the residential institute and work with her or him on their practicum. This will not only provide a research experience opportunity for the individual student, it will also prepare the student provide peer mentoring to other students at their home or other MSI institutions.

VI. Dissemination Plan
To raise the awareness of presidents and other administrators at MSIs and other institutions, and to encourage planning for and participation in cyberinfrastructure and e-science as well as to disseminate the nature and outcomes of the project, presentations or workshops will be held and materials distributed at AIHEC, HACU and NAFEO annual conferences and other events. A brief report on the institute and projects and practicum will be produced, as well as other brief reports as warranted by the institute sessions, projects or practicum for electronic and paper distribution. As part of the project web portal, project materials will be made available electronically and directed toward MSIs and other institutions interested in developing

minority representation in e-science and cyberinfrastructure as well as virtual collaborations with and among MSIs. Additionally, webcasts may be conducted for increasing awareness of MSIs on and developing minority participation in cyberinfrastructure and e-science.

The Management Team as well as participating MSI faculty will broadly disseminate project outcomes at national conferences and through articles in appropriate journals. For example, presentations will be solicited at the Global Grid Form and SC06 conferences. Articles on the project and outcomes will be submitted to various higher education journals, such as *EDUCAUSE Quarterly; Black Issues in Higher Education; Tribal College Journal; Chronicle of Higher Education; Hispanic Outlook in Higher Education; Review of Higher Education and Technology Source.*

VII. Management Plan
Fiscal Agent: AIHEC, HACU, and NAFEO, through the organization they jointly established, the Alliance for Equity in Higher Education, will provide the organizational framework for the project. The Institute for Higher Education Policy, which serves as the fiscal agent for the Alliance, will also provide this function for this project. In addition, IHEP will coordinate selected meetings and other activities involving all three Alliance partner organizations and their institutions.

Principal Investigator: Dr. Geoffrey Fox, Visiting Scholar for Cyberinfrastructure Development to the Alliance, will serve as Principal Investigator. He will be responsible to the Alliance and NSF for ensuring that all project-related activities and expenditures are consistent with the project plan of work. With other members of the project Management Team, he will prepare and submit the final report to NSF.

Co-Principal Investigators and Project Management Team: Karl Barnes, Director of Technology at the National Association for Equal Opportunity in Higher Education, Carrie Billy, Director of Technology and Operations at the American Indian Higher Education Consortium, and Alexander Ramírez, Executive Director for Information Technology Initiatives, Hispanic Association of Colleges and Universities, and Richard Aló, Director of the Center for Computational Science and Advanced Digital Simulations at the University of Houston Downtown will serve as co-principal investigators. Barnes, Billy and Ramírez will also serve as HBCU, Tribal College, and HSI Project Directors, respectively. Jamie Merisotis, President, IHEP, will act as Project Manager.

The principal investigator and co-principal investigators and project manager will comprise the project's Management Team and will serve as executive leadership of the program. The Team will develop, coordinate, and implement administrative strategies essential to the successful management of the project. The Team will meet at least quarterly to review and address program issues. Each MSI community representative on the Management Team will serve as a liaison between the project and their respective communities. The Management Team will be responsible for the on-going coordination of project activities and associated tasks, and he will liaise with the MSI faculty and staff participating in Institute activities. They will support the Principal Investigator in ensuring that project goals and objectives are met, and help develop progress reports to the Advisory Board and NSF as required.

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MSI CI Institute Advisory Group*:* The following have been recruited to serve on the Advisory Group, and to participate in strategic planning activities: Fran Berman, Mark Ellisman, Dan Reed, Dan Atkins, Kelvin Droegemeier, and Ian Foster, their title and affiliations are mentioned above. In addition to participating in at least one strategic planning session, the members of the Advisory Committee will meet at least once through teleconference to review the project and to make recommendations.

VIII. Evaluation Plan

Formative and summative external evaluation will play a critical role in the development, refinement, and eventual scaling of the MSI CI Institute. Dr. Julie Foertsch of the UW-Madison's Learning through Evaluation, Adaptation, and Dissemination (LEAD) Center will be serving as the external evaluation consultant for this project. As the evaluator for both the AN-MSI and PACI and educational technology programs funded by the National Science Foundation, she has years of experience assessing the impacts of technology education and implementation efforts at both research universities and Minority Serving Institutions. She has worked with the three communities of the Alliance for several years and has an intimate understanding of the cultural, pedagogical, and technological issues involved in supporting and sustaining technology development and faculty and staff IT training at MSIs.

The evaluator's data collection activities will include individual interviews with project staff, faculty participants, student participants, and relevant IT or academic administrators at participating MSIs; observations of MSI $C(I)^2$ workshops and planning sessions; evaluation surveys after each workshop/planning session and the Residential Program; online surveys of users of the MSI $C(I)^2$ Portal, and a review of the program's documents and participant projects. Data gathered by the evaluation procedures will be summarized to document, understand, and improve:

- satisfaction with program quality and experiences as reported by CI Institute partners, faculty, and students;
- quantity, quality of faculty training and support and the degree to which learning objectives were met;
- level and quality of student participation in project related activities;
- dissemination of information and curriculum products;
- reported positive and negative impact on participating institution's research programs
- degree to which goals were achieved;
- positive and negative lessons learned; and
- relevance of the lessons learned to the research on cross-cultural, multi-institutional collaboration.

On at least an annual basis, the institute and overall program will be reviewed by the oversight committee and other members of the scientific and MSI community using both the qualitative and quantitative data collected as part of the formative evaluation.   With consultation from the NSF's cognizant officer, the institute and program will be refined to better meet the strategic goals and needs of the institute, program, the CI-TEAM program and the MSI communities, and to appropriately scale the program beyond the demonstration project. A summative evaluation report based upon the previous formative evaluations will be submitted at the conclusion of the demonstration project.

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