

1. PROJECT OVERVIEW

1.1 Project Introduction

TERC proposes a five-year Infrastructure and Communications Project to implement and facilitate MSPnet, a web based, interactive, electronic community that will build capacity and enrich the knowledge base of the Math Science Partnerships (MSPs). The goals of MSPnet will be to facilitate communication and collaboration between and within the MSPs, and to provide a vehicle for dissemination to the public. Specifically, MSPnet will: 1) expand MSP projects' access to, and ability to share, resources, emerging research tools, best practices, obstacles, and strategies; 2) strengthen geographically dispersed partnerships by enhancing and sustaining dialogue through innovative collaborative tools, events, and structures; 3) create a growing archive, for both researchers and practitioners, of the lessons and accomplishments of the MSP program; 4) enhance the public's access to, and knowledge of, the MSP program; 5) conduct research on the impact of on-line formats, functionalities, and structures to enhance large-scale educational reform efforts.

The proposed grant builds on and expands the PIs' current work creating effective electronic communities to support NSF programs and systemic reform efforts. Most directly it will build on the work of LSC-Net (ESI-9812831), a successful electronic community serving 90 LSC projects, and Supporting and Understanding Sustainability in Local Systemic Change (ESI-0088027), which has created three exemplary virtual conferences on the topic of sustainability of systemic reform. The proposal is informed by a RETA design grant (MSPnet MSP-0233472) which has substantiated the critical need and desirability of such a project for the MSP projects.

1.11 Outcomes

MSP will result in:

- Increased sharing of resources, research, models, tools, challenges and strategies between the funded MSP projects, as well as increased access and knowledge of current research literature and resources emanating from NSF's Centers for Learning and Teaching, National Science Digital Library, as well as other resources from NSF and ED.
- Increased communication and sharing between partners (e.g. higher ed, schools,) and between constituencies (e.g. administrators, teacher leaders) within MSPs.
- Enhanced ability for MSPs to disseminate projects' events, research, press releases, and positive results to the public at large.

1.12 Impact

NSF has envisioned that the community composed of targeted, comprehensive, and RETA projects will create an MSP Learning Network in which leaders will "create new patterns of conversation and interaction," where real communication is practiced, with "genuine conversation around controversial topics" (Ramaley 2003). Such a community would draw strength from the respective disciplines represented, bridging cultural barriers sometimes felt between higher education and K-12 education. Scientists, mathematicians, researchers, and practitioners would not only share resources, tools, and professional development workshop designs and materials, but would also share challenges encountered and strategies deployed.

It is critical that this rich vision of a learning community be supported by an infrastructure specifically designed to foster collaboration between the participants. MSPnet proposes to create this infrastructure by providing technical capacity (e.g. collaborative tools, and events), human intervention (e.g. facilitating discourse, encouraging projects to share best practice), and resources (e.g. case studies, research papers, reports from the field) to promote the sharing of knowledge within and between the MSPs. In addition, it will also provide on-line tools for projects to communicate with the public increasing public engagement and access. Finally it will produce an evolving archive capturing the knowledge and lessons learned, for both MSP researchers and practitioners.

1.13 Connection to MSP Key Features

MSPnet will bring projects, partners, and constituents together to share strategies, models, tools, resources, and research pertaining to each of the Key Features of the MSP program which include: increasing teacher quantity, quality, and diversity, ensuring challenging courses and curricula, fostering institutional change and sustainability, creating effective partnerships, and collecting and analyzing evidence-based design and outcomes. MSPnet by its support will contribute to the accomplishment of all these key features by the MSPs, but in particular will strengthen partnerships between and within the MSPs.

2. NEED AND OBJECTIVES

2.1 The Need

MSPnet is designed to support the MSP projects in their work. The focus of these initiatives is to improve mathematics and science education and performance for all students, K-12. This will be accomplished by implementing challenging curricula, enhancing the quality, quantity, and diversity of the mathematics and science teacher workforce, and by developing evidence-based outcomes. This broad vision of reform is carried out by school districts or coalitions of districts in partnership with STEM faculty in higher education institutions.

MSP projects will encounter multiple challenges in planning, implementation, and evaluation. Projects must have ongoing communication among their partners and constituents, while learning from other MSP projects. Communication may be seen as "simply a logistical problem" but in fact excellent communication between PIs, PDs, lead staff, and evaluators at multiple sites, and between school districts and their higher education partners, is crucial to carrying out such a wide-scale project successfully. Moreover, each project is learning as it proceeds. Projects will grapple with a multiplicity of issues such as "What road blocks have other projects encountered when implementing a particular curriculum?" or "How do we engage all teachers, and move past the early adopters?" Projects' questions often reflect the struggles that the schools are going through to make reform a reality (Anderson 1996, Donahoe 1993).

MSPs will have much to learn from each other as they make mid-course corrections during the lifetime of their grants. There is a critical need to share queries, best practices, and solutions to common problems as they emerge, as well as new resources that will be of value to the entire community. The leaders of these MSP projects are building this field collectively; systemic change of all kinds is inherently experimental (Knapp 1997, Page 1995). They will know more than anyone else about the frustrations and successes of partnerships, of attempting to reach every teacher, of curriculum implementation, and of creating a coherent vision for a school system. MSPnet will provide a mechanism for their collective experience to be captured and shared in real time. In addition, each year a new round of MSP projects will be awarded. It is especially important for new projects to learn from those who have come before them, and MSPnet can facilitate that learning.

The data from our needs assessment conducted under our MSPnet RETA design grant showed that MSP project leaders are aware of these communication challenges. MSP leaders recognize the importance of enhancing communication within their project and with other MSP projects. All 12 projects returning the needs survey reported significant interest in services that would enhance communication among partners and constituents within their MSP, and 11 of 12 projects said they were interested in using MSPnet tools to enhance between MSPs.

2.2 Objectives

In order to meet the needs of the MSPs, MSPnet will:

1. Provide a clear electronic representation of, and accessible, interactive, connections to, all parts of the MSP learning network.
2. Provide MSP leaders with a central hub that will link projects to relevant resources.
3. Enable projects to learn from each other and share best practices, strategies, research and tools.

4. Enable interested MSPs to enrich interactions between partners by customizing MSPnet's collaborative tools, structures, and resources for their own particular needs and context.
5. Provide a method for projects to disseminate reports, research, news, and press releases and to share events with the public at large.
6. Contribute to knowledge about systemic change by capturing community memory through a growing archive collectively built by MSP leaders over the next 5 years.
7. Contribute to the research on collaborative communities of practice and their potential in aiding systemic reform efforts.

Project objectives will be accomplished through a three-tiered approach that supports communication between projects, within projects, and between projects and their public constituents.

3. RESEARCH BASE AND METHODOLOGY

3.1 Theoretical Framework

Our work with electronic communities is rooted in socio-cultural approaches to understanding communities of practice. Our definition of a community of practice, influenced by the work of Barab et al. (in press), Lave and Wenger (1991), Wenger (1998) and others, is: a social network of individuals engaged in a common enterprise, who have mutual interests, overlapping and distinct areas of expertise, and who construct new understandings and build the capacity of the entire community through connections, collaborative work, and sustained sharing of tacit and explicit knowledge. Such communities enhance the knowledge base of all participants while also enabling "novices" or new members to join the community and learn from the more experienced members (Lave & Wenger 1991; Vygotsky 1978). Successful communities build a sense of trust and identification among members; members feel safe not only to share artifacts, tools, and research, but also to discuss how these have been applied, their limitations, unresolved questions, and challenges. Such communities value members' participation at various levels of activity and centrality, and recognize that members' roles may change over time (Scribner 1997, Wenger 1998).

Our practice has also been influenced by writings on distributed cognition (Bell and Winn 2000; Salomon 1993; Pea 1993; Brown and Duguid 2000; Perkins 1993; Resnick et al. 1991) which analyze how knowledge is distributed among people, processes, artifacts, and resources. We also have benefited from work in the field of knowledge management which is concerned with strategies to enable useful knowledge to travel between working groups, departments and functions (Senge 1990, 1999). It has been enriched by writings on socio-technical networks which point to the importance of human to human interactions facilitated through technology in addition to on human-object interactions and by writings on socio-technical-*interactive*-networks (STIN) (Kling et al. 2001).

Our approach focuses on the importance of addressing sociability aspects in addition to a more traditional focus on usability of tools (Barab et al. in press; Preece 2000; Kim 2000; Ruopp et al. 1993) the essential role of facilitating, moderating, and supporting such communities (Collison et al. 2000; Spitzer et al. 1994; Ruopp et al. 1993; Falk and Drayton to appear) and effective strategies for inviting and maintaining participation (Barab et al. 2001; Bonk and Cunningham 1998).

Last, our understanding of designing electronic communities of practice to support authentic learning is constantly evolving as we learn from our experience building a year-long electronic community and annual virtual conferences for NSF's Local Systemic Change program (Falk and Drayton to appear). These structures have allowed the LSCs to learn from each other and to have honest exchanges sharing both successes and roadblocks to achieving their vision. Facilitating such a community has required that the PIs be grounded in effective practices for creating on-line environments, understand constituents' comfort level with technology, have insight into the cultural discourse (both online and offline), and be knowledgeable about mathematics and science teaching and learning, and large-scale educational reform.

3.2 Relationship to Prior Work

Falk and Drayton, directors of TERC's Center for School Reform, have been deeply involved in creating and facilitating on-line communities of practice related to science and mathematics education. Early efforts began with Labnet 1988-92 (TPE 8850465) and Teacher Enhancement Electronic Communications Hall (TEECH)(ESI-9355605), a network for all leaders of NSF teacher enhancement grants. Most recently Falk and Drayton have been PIs of three NSF projects related to communities of practice. These are: Eyes to the Future (HRD9906153), a project connecting middle school girls, high school girls, and scientists in a year-long mentoring relationship; LSC-Net (NSF/ ESI 9812831), a community of practice for PIs, PDs, teacher leaders and evaluators of NSF's Local Systemic Change Projects; and Sustainability (NSF/ ESI 0088027), a project that has created three virtual conferences for the LSC program.

In addition the PIs have broad experience leading science and mathematics reform efforts, NSF curriculum projects (Ecology Curriculum, Astrobiology), NSF and ED science teacher enhancement projects (TEPE, Hands on Elementary Science), and NSF-funded research on implementation of inquiry-based science (The Inquiry Based Classroom). While all of the above inform the current proposal and provide the PIs with a broad perspective, this section focuses on two projects that have served NSF's LSC community. We also provide a brief summary of work on a current MSPnet RETA design grant (MSP-0233472) received in 2002.

3.21 LSC-Net (ESI 9812831, Falk and Drayton, Principal Investigators)

LSC-Net was funded in 1998 with the purpose of creating a community of practice for lead staff and evaluators of the 90 NSF Local Systemic Change Projects (<http://lsc-net.terc.edu>). LSC-Net enables projects to communicate with each other, sharing best practices, queries and replies, discussions, bulletin boards, annual reports, research findings, resources, and case studies. During years when the program hosted annual face-to-face PI meetings, LSC-Net provided conference registration as well as pre- and post-conference activities.

Although the initial LSC-Net grant did not anticipate involvement of post-funded projects, all LSC projects have chosen to continue participating on LSC-Net. While the LSC program is waning, LSC-Net registration continues to grow yearly, with now over 800 registered members receiving our weekly "What's New" bulletins. In the 2000-2001 year, over 82% of projects (including funded and post-funded projects) actively engaged with the site over any four week period. The network has proven valuable both to current LSC projects and to those seeking to sustain their work. One PI wrote: *Our continued access to LSC-net beyond the grant helps maintain connections to successful practices, implementation and sustainability issues, networking opportunities by e-mail, and keeps us abreast of the research to inform our programs.*

MSPnet will leverage lessons learned on facilitating a year-long collaborative community for leaders of systemic reform, collaborative tools developed to foster interactivity, permission structures to ensure privacy, and administrative structures to allow for the collecting of quantitative and qualitative data to research effectiveness.

3.22 Supporting and Understanding Sustainability in Local Systemic Change (ESI-0088027, Falk and Drayton PIs)

This project, funded in 2000 to serve NSF's Local Systemic Change Program, combines a research agenda on understanding systemic change with yearly virtual conferences which bring researchers and practitioners together.

Each virtual conference combines an interactive keynote address, panels, an interactive poster hall, and discussants who provided summary reflections. Over the three conferences, 64 LSC projects will have presented interactive posters that reflect on factors that promote or inhibit the achievement and sustainability of their vision of reform. Project leaders have been able to share their work and discuss it with nationally recognized leaders such as Larry Cuban, Michael Fullan, Ann Lieberman, Judith Warren Little, and Deborah Ball.

Last year, over a ten-day period, the site received 25,534 page views and the archive continues to be accessed. Our statistics show that once participants came to the site, they gave it in-depth attention. (There were 1,405 "sessions" with an average session lasting 25 minutes).

Post-conference evaluations have been extremely positive. Many comments such as the following were received:

I was able to join the conversation at my own convenience...This allows for soak time and an opportunity to revisit the arguments over time with my colleagues who were unable to participate. I also appreciate the fact that the resources that participants referenced were readily available. Another big plus - I could attend ALL sessions! I didn't have to pick and choose and be disappointed because I couldn't get to all the sessions.

This conference presents us with a wonderful opportunity to get to know other people in the nation doing a similar job. By sharing experiences we may learn about errors and the solutions to common problems. Often times, we have tendency to believe that our difficulties are unique, but they are not. This conference enables us to minimize failure and prevent us from making the same mistakes that other projects made.

While writing this grant, we are preparing for our third virtual conference to be held May 13-22nd, 2003. We have already received over 360 registrants.

MSPnet will benefit from our expertise in creating and facilitating virtual conferences and interactive events that promote in-depth, honest dialogue between projects involved in mathematics and science reform. Technical development involved in creating interactive formats such as TERC's innovative "interactive poster hall", experience in integrating video and audio, and contacts with leaders in the field of systemic reform efforts, will be leveraged.

Reviewers are invited to view archives of recent virtual conferences at:

<http://sustainability2003.terc.edu> and <http://sustainability2002.terc.edu>

3.23 MSPnet RETA design grant 9/02-9/03 (MSP-0233472, Falk and Drayton PIs)

In Sept 2002, TERC received a one year RETA design grant to explore issues around designing and implementing MSPnet. This work has involved three major components:

Planning Site: <http://mspnet-planning.org> We have created an on-line planning site to give MSP leaders examples of certain functionalities, to help us discuss and explore their preferences and needs. This site was not intended as a prototype. We invite reviewers to look at it, and especially at a short Flash presentation presenting our vision, found in the Planning MSPnet section of the site.

NOTE: Since full functionality (eg. being able to post or being able to see contact info) is restricted to members we provide a temporary, anonymous account for NSF reviewers. Please log in using NSFdemo@terc.edu for both email and password.

The planning site contains:

- Planning MSPnet:
 - Please see 90-second Flash video, "Our Vision of MSPnet"
 - Needs Survey Instrument and Summary Results
 - Demos: links to two Virtual Conferences
- Example of Community Center: interactive database with email functionality
- Example of Resource Center
- Example of Library

Needs Assessment: We began the needs assessment with an intensive analysis of all funded MSP proposals, examining each project's partnership structures, objectives, and plans for within-project communication. On the basis of this analysis, we developed a needs survey. In March 2003 we mailed the needs survey to 15 MSP projects; we have received answers from 12 projects to date. We refer to the survey results throughout this proposal; complete results are posted on the MSPnet planning site, <http://mspnet-planning.org>

Of the 12 projects responding, 11 are either "interested" or "very interested" in participating in a community of practice that would increase communication *between* the MSPs. All 12 projects expressed interest or extreme interest in services that would enhance communication among partners and constituents *within* their MSP, and 11 of 12 projects said that they were

interested or extremely interested in using MSPnet tools that would enhance communication with the public. Respondents felt that such a service would help to complement face-to-face communication that was often hampered by time, schedule and geographical distance. All respondents were very interested in receiving weekly updates on resources.

Building Partnerships: Our work in the design grant will continue through the summer as we design and experiment with new tools and functionalities, and forge partnerships that will strengthen a future MSPnet while also connecting the MSP community with particular expertise, such as with the NSDL or uses of video (see Section 5.11 below for further details).

3.3 Lessons learned that will inform MSPnet design

The proposed MSPnet rests on several important principles growing out of our experience creating communities of practice for the NSF Teacher Enhancement program and for the Local Systemic Change initiatives. These lessons are also supported in the literature on effective electronic communities of practice (Falk 1996, Falk and Drayton 1997, Rheingold 1994, Collison et. al. 2000, Ruopp et al. 1993, Dede 1988, Kim 2000). These principles will guide our development of MSPnet.

3.31 An electronic community should be an integral part of the work of the MSPs.

Participants must see the network as relevant to and integrated with their work. An essential continuing task for MSPnet staff will be to engage with the MSPs, to identify areas of broad interest as well as targeted interest groups so that the site responsively addresses participants' interests and concerns and thereby facilitates a meaningful learning community.

3.32 An electronic community does not run itself.

The development of a robust, accessible, and flexible structure is just one piece of the network system. The network can not be thought of in isolation from the critical intellectual work that takes place in the background. The work we propose involves both technical and knowledge engineering. The proposed MSPnet will require facilitation, monitoring, and ongoing technical and academic support. It will require staff knowledgeable in the field to summarize, annotate, and publicize key findings, research, and programs that are salutary.

3.33 An electronic network must be designed to be a time saver rather than a time drain.

Leaders cannot be expected to have time to continuously "surf" for relevant information. MSPnet should serve to coordinate, highlight and synthesize resources and to serve as an effective conduit to (RETA) research, evaluation, and other technical assistance grants. Participants need to know that there is a central hub that will connect and direct them to relevant resources. In addition, structures such as weekly e-mail "What's New" bulletins helps participants to know when it is useful for them to return to the site.

3.34 A culture of trust enables members to feel "safe" in sharing successes and challenges.

It is of great importance that a network such as MSPnet NOT be seen as an evaluation tool that will result in projects (and their lead staff) being either "rewarded" or "reprimanded." This is critical to foster authentic dialogue where projects feel free not only to discuss successes but to seek advice from colleagues and to share challenges and roadblocks that they are experiencing in implementing their vision. Features of MSPnet such as private arenas for special interest groups, and permitting queries to be posted anonymously, will help to reduce the anxiety of some about participating in frank discussions or sharing questions that will reveal a weakness in public. A culture of trust must be established and reaffirmed in the way discussions are moderated, and in the way dissenting viewpoints are addressed and respected.

3.35 On-line and face-to-face communication are mutually reinforcing.

We learned from our experiences with LSC-Net that interactions on the network were enriched through building connections to annual PI meetings. The conference provided an opportunity to put a "real face" on the people that were engaged in electronic dialogue and built personal relationships between the participants and the staff that was running the network. Conversely, the on-line community allowed discussion at the PI conference to be extended, and extended the meeting's reach to staff who were not present at the PI meeting.

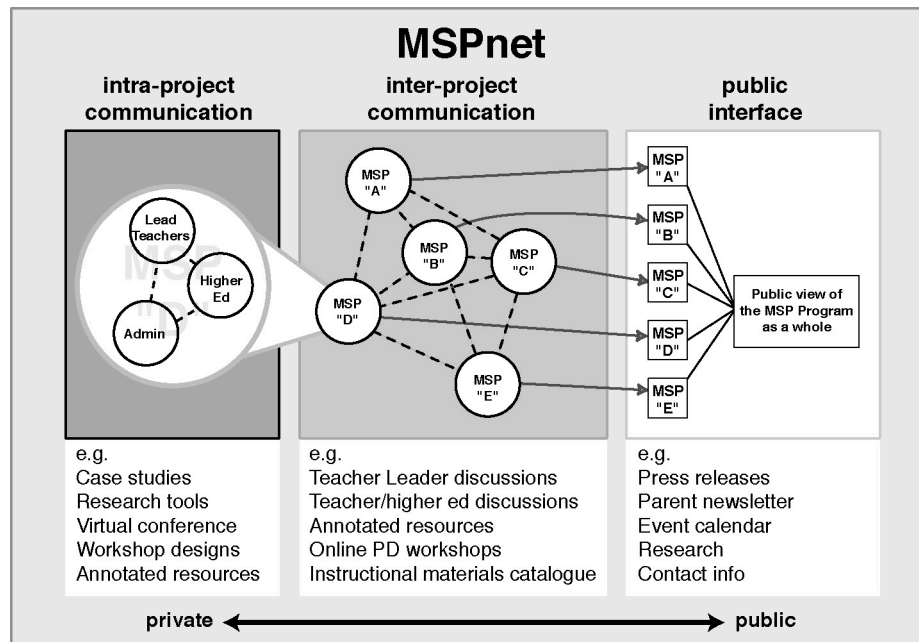
4. DESIGN OVERVIEW

4.1 A Three-tiered Approach

We will adopt a three-tiered approach that will create three seamlessly interwoven levels of interactivity. The first, MSPnet Inter-Project Communication, facilitates dialogue and sharing across the MSPs, the second, Within-MSP Communication, facilitates dialogue between partners within an MSP and is private to only members (e.g. administrators, teachers, partners) of a particular MSP, and the third, Project to Public Communication, supports individual MSPs' communication to the public.

An underlying database structure and object-oriented design are used to ensure different levels of access to these three tiers, dependent on the participants' relationship to the MSP (eg, PI vs teacher vs public). Hence while project staff will be able to move seamlessly between the project internal communication space and the public space, the public will not have access to communications that take place within internal project space.

The three tiers are graphically depicted below:



4.11 MSPnet Inter-Project Community Space

The Inter-Project Community Space provides the connective tissue, the roadmap, the meeting place as well as a means to capture community memory for all MSP and RETA projects. It provides a protected space for projects to learn from and with each other over time. It will enable the exchange of resources and reports from the field such as research reports as they emerge, text and video case studies of teaching and learning, excerpts from project annual reports, tools for data collection, teacher PD workshop designs and intervention models, news clippings and press announcements, presentations given by MSP leaders at professional conferences, human resources for PD (e.g. exemplary speakers or workshop facilitators). Projects will be able to select an artifact or group of artifacts (e.g. video case studies) and attach them to a discussion, allowing team members to discuss and analyze the materials with colleagues from within their own project and from other MSPs.

This community space will include structures that facilitate year-round communication as well as shorter, special interactive events. Tools will facilitate both asynchronous and synchronous interaction and will provide connections between site based communication and

email notification and dialogue. These tools will be organized into virtual spaces which will include a community center (interactive database with integrated mail group and individual email functionality), a discussion hall (asynchronous collaborative tools), a meeting hall (synchronous collaborative tools), a library, a resource center (text, graphic and video resources with integrated annotation and discussion tools), and an interactive conference center (interactive speakers, panels, discussants, posters, full conferences). These are described in more detail below.

The lead staff of each project (higher education partners, K-12 administrators, professional developers, lead teachers, evaluators, and all PIs and co-PIs of targeted, comprehensive, and RETA grants) will benefit from having each of the following:

- a clear electronic representation of, and accessible, interactive, connections to all constituent parts of the MSP learning network,
- connections to important resources, that are organized and summarized by TERC staff, and can be annotated and discussed by the community,
- tools and structures to enable collaboration between the MSP projects,
- an evolving archive of the knowledge represented by the MSP community.

In addition to serving the needs of the community as a whole, MSPnet staff will foster the emergence of, and facilitate interaction between, smaller communities of practice who share common expertise, have common roles across projects, or have mutual special interests. Some examples of cross-project communication are higher ed faculty across several MSPs, several "buddy projects" that are all using video as an integral part of their professional development, a RETA project that is working with a subset of the MSP projects on a particular research project.

Our needs survey showed that MSP project leaders were interested in having communication and sharing across the MSPs. All 12 respondents said that having such a community would be either extremely valuable (6 projects) or valuable (6 projects) to their work. The functionalities that were rated highest were an online library with connections to resources, interactive poster halls, virtual conferences, and an interactive searchable database across the MSPs.

4.12 Intra-project (within-project) Communication

In addition to providing a collaborative space across the entire MSP Learning Network, MSPnet will also provide projects with individual space, and the ability to use the collaborative tools with their own constituencies and partners within their MSP. The web-site architecture and "permission system" will enable only members of a particular project to see and participate at this level. On the basis of information gathered in our needs survey, we will begin by providing projects with a palette of tools that will include a communication center, discussion hall, meeting hall, library, resource center, and interactive conference center. These tools will enable such activities as virtual meetings among partners at a distance; follow-up discussions after conferences or workshops; mentoring relationships between teachers and higher ed faculty; consultations among teacher leaders from across a project for collegial support and planning. Project sites will also include an on-line training center where projects are provided with tutorials on creating and fostering on-line collaborations within their projects. These training materials will emerge from intensive face-to-face work with a subset of projects during our first year, but from the needs survey we anticipate that it will include:

- tutorials on how to create the communication center's project database (using our templates),
- essential tips on creating and moderating successful discussions,
- step by step directions for building a customized on-line resource center which would enable leaders to copy references from the inter-project space (and discuss them within a project),
- instruction to create a virtual catalogue of resources (science kits, videos, storyboards) available within a project while allowing teachers to annotate resources and discuss how they were implemented,

- a Flash movie on creating on-line conference events,
- answers to frequently asked questions.

All the MSPs will be expected to forge new partnerships or strengthen existing partnerships between higher education faculty and school districts. While these partnerships bring new opportunities they also bring large communications challenges. Our needs assessment has shown that MSPs feel a need for on-line collaborative tools that will help support partnerships; 6 reporting "interest" and 6 "extreme interest" in this service. Most projects report that their current communications infrastructure is limited to e-mail and phone which is limited in providing larger group communication. One project mentions video conferencing, and another project mentions implementing a teacher log reporting system. Interestingly, projects that already had a web-site in place seemed more eager for MSPnet services, rather than being less so. This suggests that projects that have already invested some thought in on-line communication are perhaps more "ready" to move towards collaborative tools than those projects that have not yet thought about it. During the first year of MSPnet we will work with a subset of "early adopter projects" that have the greatest need for, interest in, and commitment to technical support. We will learn from these projects, and then move to provide these tools for other projects in successive years. We anticipate working intensively with 2-5 projects per year, and that by the end of the 5 years of this grant we will have supported the creation of internal MSPnets in 15-20 MSP projects.

4.13 Project to Public Communication

MSPnet will provide projects with authoring tools, templates, training materials, and support to enhance their ability to communicate with the public. These tools will enable projects to publish project descriptions, contact info, create newsletters, post press releases, and post an updateable, searchable calendar of events. This tool set has been chosen in response to needs expressed by MSP leaders' comments on their surveys.

Lack of support from parents, business, and government can severely undermine the work done within an MSP. Successful systemic reform projects expend significant time and energy in the area of public relations (Frascella, Merlino, and Bohlin 2002). MSP PIs responding to our survey acknowledge the importance of public outreach, but several report that they have not yet had time to think about this. In general it was rated as a lower priority than intra- or inter-project communication. Of 12 projects surveyed, five wrote that they needed most help communicating with other MSPs, five wrote that they needed most help enhancing communication within their MSP, one wrote they needed most help communicating with the public, and one responded that they needed help in all three equally.

The tools and templates we propose would enable projects who did not have any plans to create a public web-site (5 of 12 projects surveyed) to have an initial public presence. Those projects which had already created a public site (4 of 12) or had plans to do so in the future (3 of 12) were interested in having tools from MSPnet that would supplement and enhance their site's current functionalities: "Our web site is limited and is in need of development."

Beyond helping individual MSPs to connect with their public constituencies, MSPnet will create a unified public view of all MSP projects' web-sites. By doing so, MSPnet will enhance public access and increase dissemination and visibility of the MSP program as a whole.

4.2 Design Approach

We provide here a design overview recognizing that functionalities will be added and changed over time as the Internet evolves, connectivity increases, and new technologies become more widely accessible. While the sophistication of Web capabilities will grow over the next five years, our commitment is to use this forum as a tool to serve the needs of the community, and not to experiment with cutting edge technology for its own sake. At the foundation of our design will always be a concern for easy navigation, time saving shortcuts for users, providing technical assistance whenever necessary, and providing simple tools for users to update, add, submit, and annotate information. Our design seeks to provide both ongoing dialogue and short term events, asynchronous and synchronous communication, tools to enable sharing of tools, research, and resources but also tools to foster discussion and reflection.

Rather than describing tools in technical terms we will speak of their functions, relating them to the goals that we wish to achieve — using the "virtual space metaphors" we have found effective. In some instances we point to prototypes of these tools which we have developed under other NSF funding, and which we will leverage for this grant.

4.21 Community Center

The community center will provide interactive connections to all constituent parts of the MSP Learning Network. It will provide a searchable database that will contain updated information about all MSP Comprehensive, Targeted, and RETA projects and their staff. Registered users can update their personal information and project PIs can update their project abstracts and contact info. Registered users may register project members to the site ensuring that the database stays current as new MSP staff are added. The community center provides a sophisticated search engine that allows users to search the database by job title, geographic location, subject focus, grade levels, or with a text search. Users can send group or individual emails to people or projects directly from the site. Users can, for example, search the database, seeking higher ed. partners. They can then save this group for later conversation or they can send an email to the whole of this group, or any subset, with a single keystroke directly from the site. Registered users can update their personal information and project PIs can update their project abstracts and contact info.

To see an example of the community center created with the participant list from the last MSP PI meeting, go to: <http://mspnet-planning.org> Since only logged-in members can see contact information we have created an anonymous email and password for reviewers. Password and email are **NSFdemo@terc.edu**

4.22 Discussion Hall

The discussion hall will contain discussions on topics of interest to the MSP community. Members will be invited to participate in threaded discussions which members can elect to receive and post to directly through their email. Papers and Resources on the site can be selected for discussion. MSPnet will also have continuous Special Interest Forums that serve particular constituencies. These forums will have asynchronous and synchronous functionalities and will have a forum moderator. A third format for discussion will be "Queries and Replies." This functionality enables a participant to post a query to colleagues, anonymously or with attribution. The submitter of a query will receive automatic email notification when their query is responded to. Finally, a Bulletin Board will enable participants to share messages of general interest (job opportunities, recruiting for a workshop, announcing publication of a new book) to the community.

4.22 Meeting Hall

In MSPnet's Meeting Hall, groups of members can set up and conduct synchronous meetings. The meeting room will include a chat space as well as a shared white board. Artifacts, work-in-progress, and resources, including both text, video, and multimedia, can be discussed in real time.

4.23 Library

This area will contain a searchable on-line library of reports, papers, and research on science and math learning or teaching, large-scale educational reform, policy implementation, scientist-educator partnerships, and similar topics. Such resources will be drawn from NSF's Centers for Learning and Teaching, future Science of Learning Centers, the U.S. Department of Education, NSDL, as well as recognized databases and repositories such as National Center for Educational Statistics, the National Academies, and CPRE. The library will also link and highlight relevant reports and announcements posted on the NSF web-site which may often go unnoticed by MSP project. Input from NSF program officers will be sought in identifying new, relevant NSF resources.

Our most important informants about valuable resources will be the MSPs themselves, as they share resources for their colleagues, or request resources on particular topics. The papers will be shared for information and discussion, not for advocacy. They will in all cases be available free of charge. MSPnet staff will provide annotated highlights, summaries, and weekly updates to aid MSP leaders who are likely to lack the time to organize, synthesize, and sort through papers. Projects will be able to rate their areas of special interest to receive updates on papers that are most aligned with their work.

4.24 Resource Center

The resource center will contain a wealth of material that is generated by, and useful to, MSP projects. These will include research tools, case studies, research findings, professional development workshop materials, and student and teacher case studies. There will also be an updated annual calendar of relevant professional conferences, and pertinent professional organizations and web-sites. We will provide users with the ability to post resources, annotate resources and rate them. Participants will also be able to discuss a particular resource with colleagues or to select a group of related resources (e.g. a collection of four related videos) to discuss. Participants in the community will be able to post new resources to the site, share comments about how they were used, select subgroups of resources to discuss with colleagues, and save favorite resources in a customized personal file.

4.25 Poster Hall

This innovative format provides a mechanism for people to create posters to share and discuss with their colleagues. Participants who enter a virtual poster hall will have an experience similar to going to a poster hall session at AERA. An icon will tell them when the poster presenter is on line for synchronous conversation. They will also be able to leave comments or queries in a threaded, asynchronous discussion. This format will also provide a mechanism for MSPnet participants to select a group of artifacts already on the site (which can be any combination of text, audio, and video) to be discussed in relation to each other. To see an example of a poster hall go to <http://sustainability2002.terc.edu/nav.cfm/posterhall/enter>

4.26 Virtual Conference Space

The virtual conference space will provide varying formats for short-term (two days to three week) events. TERC will engage speakers, panels, presenters, and discussants from the MSP community as well as other recognized leaders in the field in interactive events with participants. To see an archive of a virtual conference (with keynote, interactive speakers, panelists, interactive poster hall, and discussants), see <http://sustainability2002.terc.edu>

5.0. PLAN OF WORK

5.1 Activities to be undertaken

The work of the MSPnet project falls into four major categories:

- Technical design, development, testing, and revision cycle
- Service Component
- Engagement with MSP and RETA projects
- Formative Evaluation and Research

5.11 Technical design, development, testing, and revision cycle

While MSPnet will leverage collaborative tools that were developed under other NSF funding (e.g. LSC-Net, MSPnet design grant, Sustainability Virtual Conferences) this grant still involves a significant research and development effort to enhance all functionalities, incorporate advanced multimedia and video capabilities, customize functionalities for individual MSPs, etc. Further, the development will not be a one-time event, but an iterative process, allowing MSPnet to grow as the Internet evolves, and as our participants enhance their connectivity. As part of our research and development cycle, we will:

- identify a key set of experimental functionalities or enhancements that we will target to implement each year. We will assemble a small task force drawing from our advisory board and other leaders in the field to examine related work being done.
- After designing a prototype we will test new functionalities within an MSP test-bed site that has expressed a particular interest (e.g. in video sharing and discussion).
- In addition, new functionality will be tested by an independent group of design testers who will provide design feedback as well as technical feedback. This will provide an ideal balance between audience-specific testing and professionally oriented testing.
- We will then modify and adjust functionalities before offering such functionalities more broadly to the community.

While the majority of functionalities that will appear on the MSPnet site will be designed, created, and tested at TERC, there will also be efforts that will integrate the work of other leaders in the field through collaborative partnership efforts.

One such potential is the integration of tools that allow the video capture of classroom practice and discussions. MSPnet has already been in contact with both Lesson Lab (James Stigler) and the Inquiry Learning Form (Sasha Barab) concerning future collaborative efforts to integrate the exemplary work that they have pioneered. Both Stigler and Barab are on our advisory board and will participate in a series of workshops on integrating video within MSPnet. Colleagues at WGBH who have also expressed an interest in coordinating future activities with MSPnet will join them. Another example of collaboration will be to bridge MSPnet with some of the exemplary work being done through the National Science Digital Library. James Dorward (PI of NSDL's Instructional Architect) has also expressed an interest in collaborating with MSPnet and he is also a member of our advisory board.

5.12 Service Component

TERC's MSPnet staff will be responsible for both creating the structures for year-round special interest groups and moderated discussions as well as ensuring the availability of time limited special events such as guest speakers with discussions, virtual poster hall events, highlights from MSP projects, and virtual conferences.

Second, MSPnet will also support yearly PI meetings through pre- and post-conference activities, and by posting papers and presentations so that they can be shared and discussed after the conference by lead staff who were in attendance as well as by other staff who were not able to attend.

A third essential service that MSPnet will provide will be on-going information-management support. We will mount and co-moderate discussion groups with leaders of MSP projects, send out weekly announcements of new resources and events on MSPnet, call for participation encouraging submissions of reports from the field, research, and resources from

the community, and highlight findings, strategies, and structures being employed by different MSPs. MSPnet staff will also summarize, synthesize, annotate resources, to prevent information overload.

MSPnet will engage in a continuous effort to create a program archive that will capture community memory. This archive of resources, research, models, tools, strategies, and discussions will serve both the current MSP community as well as projects that are funded in subsequent years who wish to learn from the experiences of "veteran" MSPs. Building this archive is both a technical and a human endeavor. It will entail not only the development of robust design for databases and collections of information, but also a process for continually keeping abreast of the developments within the MSPs. Last, MSPnet staff will provide ongoing technical support to assure ease of use of all aspects of the site.

The goal of the service component is to help members make the best use of the site, which includes integration of new members, trouble shooting, knowledge management, and helping people find ways to learn from each other using the resources they help to provide. In addition, TERC will provide significant outreach through print and electronic communications to ensure that members are aware of resources and events hosted on the site.

5.13 Engagement with MSP Comprehensive, Targeted and RETA projects

Based on our experience running a community of practice for NSF's LSC program, we anticipate that all MSP projects, including comprehensive, targeted, and RETA projects will participate during the year. Some will use the site weekly, others less frequently, some will host and moderate events, others will choose to read only. Some will use the functionalities more actively within their project and more passively when communicating with other projects, and modes of interaction will change over time, as the needs of projects evolve.

Our needs survey has indicated that there is a significant subset of projects (6 interested, 6 extremely interested out of 12 respondents) who wish to use customized versions of MSPnet to foster communication, collaboration, and reflection between partners within their MSP. Each year we will work intensively with a subset of projects who are most interested in customizing MSPnet collaborative tools for their own purposes. These collaborations will yield mutual benefit, as they will not only serve an individual project's needs; the project will also serve as an MSPnet test-bed, as we explore and research the use of electronic collaborations in fostering and strengthening partnerships. Projects chosen for partnership relationships will have

- expressed a strong desire to work closely with MSPnet
- have technical capacity and incentive to update, moderate, and maintain an electronic community
- are willing to pilot new tools and to provide feedback on how functionalities are being used to enhance partnerships and communication structures.

Our needs survey has indicated that there will be a significant percentage of projects who will desire and seek out such a relationship.

5.14 Research and Evaluation

MSPnet staff will conduct formative evaluation, and also research on aspects of MSPnet use and impact. The web-site will be designed to facilitate the collection and analysis of both quantitative and qualitative data to aid both these efforts.

Formative evaluation: Ongoing formative research will enable us to have a clear view of how the site is serving the MSP community. Such research will enable MSPnet to be more effective in reaching out to segments of the community that are not interacting with the site, to inform site administrators of technical problems that are being encountered, to indicate what areas of the site are most active or need further enhancements, and to gauge the success of specific interventions with the community.

In order to support effective formative evaluation the MSPnet site will have a sophisticated "behind the scenes" administrative area, based on tools and protocols developed for LSC-Net. This administrative area permits project staff to monitor activity on the site on a weekly basis by individual, by project, by number of hits, and by number of visitors. In addition

it allows research staff to monitor relative activity for different functionalities such as posting, browsing, discussing, etc. In addition we are able to gauge the effectiveness of TERC's interventions, such as summarizing and highlighting projects' reports from the field. The tools will also archive all suggestions, comments, or requests for help that users send through the site. This information will be collected and analyzed on a weekly basis and will enable effective formative research that will inform changes to the site such as the addition of new technical features or content areas. In addition to information gained from the administrative area of the site, we will solicit yearly feedback from constituents on how the site is serving their needs.

Research on the electronic community: While this project is primarily a technical assistance grant it will present multiple opportunities for research on the role that collaborative networks can play in strengthening partnerships between and within MSP projects. TERC is well poised to conduct research on electronic communities of practice and doing so is a particular interest of the Principal Investigators.

Our research will include "applied" investigations of the uses of technologies to support MSP activities. We will investigate the use of MSPnet tools and of tools created by projects independently to facilitate partnerships within an MSP. MSPnet will highlight creative solutions that individual MSPs have produced, and when found to be effective, will incorporate these tools into the MSPnet so that they can be used by other MSPs. A five year sustained network community will allow us to study the integration of telecommunications technology within a professional development effort over time. We will report on relative use of multiple on-line tools, methods of facilitation of the community, barriers to site use, aspects of interface design, and experimental interventions with specific technologies and subgroups.

In addition, the content posted in discussions and in the sharing of best practices will present opportunities for research on challenges faced by systemic reform. Virtual conferences focused on a specific theme, which invite interactive poster presentations from MSPs, will be a rich data source, and can be accompanied by follow-up questionnaires and interviews.

A series of studies will be developed within the general socio-cultural framework outlined in Section 3.1, above. We will involve graduate students studying Technology in Education at Harvard and elsewhere in the research building capacity in the field. Research topics will likely include: 1) the nature of content exchanged between projects; 2) key issues that arise in partnerships between scientists and school districts; 3) effective ways of bridging cultural differences in these partnerships; 4) methods to study learning, the development of insight and new knowledge, as evidenced in exchanges e.g. within SIGs or "job-alike" staff in different projects, or between partners within a project; 5) how patterns of collegial communication change over time with the addition of new technologies to a project's communications "tool kit."

5.2 Timeline

The content, design, and activities of MSPnet will be shaped the interactions with the community. We will engage in a continuous process of technical development, testing, and implementation, engagement with the MSP community and providing of knowledge management services, formative evaluation and reflection, including dialogue with the members of the community, staff review, and annual reviews with our Advisory Board.

Fall '03 to spring '04 (0-6 months) The first six months of the project will be dedicated for start-up, implementation of web-site design, quality assurance and testing, launch of between-project tools, initial coordination and site visits with three test-bed MSPs that will use collaborative tools to enhance partnerships; having our first annual Advisory Board meeting.

Spring '04 to Fall '05 (6-12 mos.) The second six months will focus on development, quality control testing and launch of within-project communication sites, and project to public communication tools. During this period we will develop support materials for individual MSPs to use when implementing within project, and project to public communication tools. We will work closely with 2-3 MSP projects to incorporate MSPnet within their project to improve the communication infrastructure between partners, and evaluate its use, effectiveness, and identify challenges, and unresolved issues to address.

(Successive 12 month cycles) Every twelve-month cycle after the initial 12 months will follow similar patterns of:

- interactive development and testing cycle to incorporate new functionalities,
- providing year-round structures, and functionalities and events to MSPs,
- service component to synthesize, highlight, and archive material,
- pre and post conference activities supporting annual PI conference,
- continued collaborations with MSP and RETA projects to facilitate hosting, moderating, posting, of resources, tools and events,
- work with 2-5 MSP projects per year incorporating within-project communication,
- formative evaluation and research efforts,
- advisory board meetings.

6.0 PROJECT MANAGEMENT

6.1 Institutional Capacity

TERC, founded in 1965, is internationally recognized for its work in advancing creative and integrated uses of technology in education; building network-based communities; strengthening science, mathematics, and technology education with innovative curriculum and teacher enhancement programs; developing imaginative tools (software, hardware, and instrumentation) for students of all ages; and increasing equitable opportunities for female, disadvantaged, and disabled learners. TERC's technical infrastructure includes a fully-staged development/test/production web environment, co-located web hosting facilities serving over 40 project sites, a diverse team of web developers, and a professional network and systems administration staff.

6.2 Senior Staff

The proposed project will be housed at TERC, and directed by Joni Falk and Brian Drayton, co-directors of TERC's Center for School Reform (CSR). Falk and Drayton have been PIs of multiple NSF projects involving communities of practice including LSC-Net, Eyes to the Future, Sustainability, and MSPnet RETA design grant. Falk's area of interests include formative evaluation and assessment, research on electronic communities, and inquiry-based learning. Drayton is a linguist and a scientist and has a special interest in discourse analysis and science curriculum and pedagogy. The project will use a seasoned technical development team, including Jon Obuchowski, and Lance Lockwood, both of whom took leadership roles in creating virtual conference platforms and communication tools used in Sustainability and LSC-Net. Dr. Soo-Young Lee will direct evaluation.

7.0. ADVISORY BOARD

We are pleased to have assembled a distinguished advisory board which will provide significant insight and expertise in electronic communities of practice, mathematics and science teaching and learning, and innovative technologies. Professors Christopher Dede and Stone Wiske of the Harvard Graduate School of Education bring extensive experience and research on technology in education and electronic communities; James Stigler, Professor of Psychology, UCLA, and director of TIMSS, and Prof. Sasha Barab from the University of Indiana bring special expertise in the use of video and related technologies in teacher professional development and electronic communities. Dr. Daniel Gruen from Lotus/IBM and Dr. Geoffrey Bock of the Patricia Seybold group provide insight from their work in the private sector around collaborative software environments. James Dorward from Utah State University, is a PI of a both an MSP RETA project, as well as an exemplary NSDL project. He will provide insight on efforts to leverage NSDL resources within MSPnet. In addition, our final board will include two PIs from targeted or comprehensive MSP projects.