Chapter XXXIX
Enabling Remote Participation in Research[1]

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ABSTRACT

This chapter uses the theoretical notion of common ground to explore remote participation in experimental research. On one hand, there is a desire to give remote participants the same views and capabilities that they would have as local participants. On the other, there are settings where experimental specimens and apparatus are large and difficult to effectively manipulate or view from a remote vantage point, and where multiple and diverse perspectives may be useful in decision making. In exploring these issues, the authors draw on two studies of researchers in the earthquake engineering community. The first, an interview study about attitudes toward teleparticipation, suggests that engineers are wary of remote participation because they fear the inability to adequately detect signs of potential failure. The second study, an observational study of researchers conducting an experiment in a centrifuge facility, illustrates that researchers adapt to the available information, and that diverse perspectives and information may be valuable in troubleshooting.

The way a team plays as a whole determines its success. You may have the greatest bunch of individual stars in the world, but if they don't play together, the club won't be worth a dime.

—Babe Ruth

INTRODUCTION

Ubiquitous information and communication technologies are having transformative effects on the ways in which people socialize and work together. In particular, "virtual organizations"—aggregations of individuals, facilities and resources that span geographic and institutional boundaries—are an increasingly common work structure in a range of settings (DeSanctis and Monge, 1998). Virtual organizations enable interaction between individuals with diverse and varied perspectives who might not otherwise work together (Birnholtz and Horn, 2007), the sharing of expensive and scarce resources (Finholt, 2003, Kouzes and Wulf, 1996), and allow for novel ways of accomplishing tasks and solving problems (Atkins et al., 2003, Nentwich, 2003).

Among the many potential benefits of these technologies, the facilitation of increased access to scarce research apparatus and resources was among the first to be explored (NRC, 1993, Finholt, 2003). Consequently, a range of collaboratory projects have sought to increase access to and aggregate data from remote shared instruments (Olson et al., 1998), and to provide remote manipulation capabilities for laboratory apparatus, such as microscopes (Kouzes and Wulf, 1996). While these examples are specific to the research domain, the lessons learned can also be applied in areas such as telemedicine or remote consultation on repair of complex devices.

A key issue when providing access to remote instruments is providing all participants in the activity, both local and remote, with enough information to have an adequate shared understanding of what is taking place—that is, what Clark and Brennan (1991) refer to as *common ground*. As Birnholtz et al. (2005) point out, however, the amount of information and interaction needed to achieve common ground depends significantly on the *grounding constraints* (Clark and Brennan, 1991) present in the specific situation at hand. Some situations require more detailed discussion and may require more information, while others have simpler requirements. How to predict in advance the grounding needs for a particular situation, however, remains an open question.

This is a particularly important question for the realm of providing shared access to research apparatus and instruments. There are a number of modes of collaboration, ranging from traditionally structured projects involving a small number of investigators working closely together, all the way to distributed "mass collaborations" like NASA Clickworkers (Kanefsky et al., 2001) or the ESP game (von Ahn and Dabbish, 2004) where distributed collaborators contribute effort, but make no intellectual contribution to the project. There's also a vast space in between these two extremes; Wikipedia, for example, probably sits more toward the latter category, but it does allow for some more cerebral contributions. Given the various grounding needs and constraints due to the wide range of participatory modes for distributed collaborators, an important design question is therefore how we should think about providing information to remote participants.

In this chapter we report on our involvement in the development of the George E. Brown, Jr. Network for Earthquake Engineering and Simulation (NEES), a cyberinfrastructure project aiming to interconnect large-scale earthquake engineering (EE) laboratories. One goal of NEES was to enable remote participation in EE research. This research area and others like it present an interesting puzzle for e-science. On the one hand, the scarcity of laboratory facilities strongly suggests the value of using network technologies to increase access by scientists at "peripheral" universities to laboratories at a small number of "core" universities. On the other hand, though, the scale and potential danger in the research seem anecdotally to lead many researchers to reject outright the idea of serious scientists participating remotely in laboratory research.

BACKGROUND: PERSPECTIVES ON PARTICIPATION

One goal of e-science and cyberinfrastructure programs is to enable new forms of geographically distributed collaboration and participation