

The Sociotechnical Interdisciplinary Challenge from the Social Scientific Perspective

Barbara O'Keefe
University of Michigan Media Union
b-okeefe@umich.edu

I would like to speak about our agenda for collaborative activity in the area of Internet2. What can the social science community do -- in partnership with the technology-development community-- to realize the benefits of Internet2 development? I am pleased to say that this meeting, for me, did what it was supposed to do. Because I'm going to leave here with a really clear agenda for my own work and for the work of my center, that I wouldn't have had, had this meeting not occurred. And that's really what I want to talk about today.

There were two things that came into focus for me at the end of the day yesterday and as I reviewed the remarks I wanted to make in today's session. The first was the diagram that we started with at the beginning of the Summit. It showed the progressive adoption and diffusion of the commodity Internet as a spiral nearing completion, as contrasted with the point we are at now with Internet2. And then I juxtaposed that diagram with Russ Neuman's very helpful remarks from yesterday [4] and his quite striking comment--that a number of us have referred to today, that it's time to think again about the value of quantitative research, especially descriptive research on patterns of technology use.

I think it is fair to say that quantitative and survey methods have been a little out of fashion in communication research of late. And this meeting has been one in which people have repeatedly pointed to the value of those kinds of studies and the need to revive a sociological method and sociological analysis of change. Now Russ actually made that point as he lead up to a plea for renewed interest in his particular topic -- social cohesion. But I'm going to ask us to step back and think about what made the topic of cohesion an interesting one earlier in this century.

I actually think the key issue is not just cohesion. I think the deeper issue is *change*.

Change is what we saw embodied in the spiral diagram. Changes, broad-scale social changes, are what motivated the intense studies of social cohesion and fragmentation that Russ talked about. And for me actually what has come into focus is the critical role of social scientists and technology developers at this particular point in dealing with change, broad-scale change, associated with technology development in society.

The main point I want to make is that we really need to understand how social science and technology development can partner in order to participate productively in social change. Here I want to talk about first, the positive side of this partnership, promoting, supporting, and managing change; then second I want to talk about resistance to change, which has been another key issue in this meeting. Then finally I want to go on and talk about the research agenda and research community that we need to build.

So the first topic is understanding social change. I think one of the themes that's been highlighted throughout the meeting is the importance of understanding that change is happening and that people are trying to understand it. Not just us. Everybody's trying to understand it. And that to a very large extent those understandings are not grounded in systematic empirical evidence and research. People have repeatedly pointed to the fact that there are these various dystopian and utopian visions of the future of network-based technologies and that those stances are themselves drivers of a lot of claims about what technology is doing or what it's going to be like and so on. This is one of the things that has been most frustrating, I think, to social scientists. So much of what's been said about technology and it's current impact and where it's going really reflects, for us, a stereotyped response to new technology. And here I would recommend any of a number of books, but particularly Carolyn

Marvin's, *When Old Technologies Were New*, [3] which offers a great analysis of the kinds of things that get said about new technologies and the kinds of common fears that arise and the ways those get played out on the public stage as new technologies enter the market. And it shows that what we hear and read about new technologies now is very similar to things that people said about the telephone and telegraph—things that embody their fears and their hopes in a world of change.

So one of the outcomes of this meeting, we hope, will be a broadened awareness of the experience of change and the rhetoric that surrounds technology change. It is critical that we not get caught in that discourse, but rather move past it and begin to build a grounded empirical, systematic, well-reasoned analysis – and in that way we can feed policy and design.

The second point I want to make about our ability to understand change is that it's really change itself now that's the issue. There are many social issues that come into play in a salient and sometimes frightening way when change occurs. And those include the kinds of things we've been talking about at this meeting:

- social solidarity or cohesion;
- status and role;
- capacity;
- who's skillful and who isn't;
- who's able to do things and who's not;
- autonomy and individuals' ability to exercise their freedom.

All of these things issues become salient as change occurs on a large scale. It is important to understand each of these issues individually, but it is also important to appreciate that their current salience is a result of the large-scale changes in access to information and communication technologies that we're experiencing now.

And so I think one of the things that we should really focus on out of this meeting is social change itself and ways of understanding that. Here the social sciences have a lot to contribute, in part because there has been so much change in the 20th Century, starting with World War I, World War II, the information revolution.

Because it has been increasingly important to understand change, we now have an enormously rich array of models within which to understand change at a number of levels. For example, theories of individual social influence are extraordinarily well-grounded right now, very well developed, very rich and capable of underwriting a lot of really interesting

predictions and models for technology-related change specifically.

What's interesting is that now we also have really exciting models of dynamic social processes beginning to emerge. We can contextualize our understanding of change at the individual level with an understanding of social networks and the dynamic changes in those networks. Scott Poole [5] referred to adaptive structuration theory that provides one good lens through which to look at that. Peter Monge, who is in the audience, has been a chief proponent in communication studies of self-organizing systems theory, which is also a productive framework and, in fact, has a lot of synergy with the kinds of work that Scott would call on. What's really interesting to me is the ways in which those new dynamic social network models at the social level have begun to absorb and integrate models that operate at the individual level. For example, one can study and model an advice network, in which dyadic exchanges of advice lead to overall flows of influence in an organization.

So to sum up my first point, I think we're in a good position to begin understanding social change. And what we need to do is start embedding our understanding of technology within those frameworks. But second, we also have an interest in promoting change. And that's one of the other things that has emerged from this meeting. In fact, from the technology side it's more a matter of promoting change than understanding it in a lot of ways. We want to develop new things. We want to create new capabilities. And we want to put them out there and see what people can do about them.

There are two related points that I think are really important here. One has to do with technology development itself. The other has to do with the way in which we prepare people to accept new developments in technology.

First I want to talk about technology development itself. It's been a truism for many social scientists that technology-driven change is bad, that one can't actually create positive change and adoption through technology development alone.

However, some recent experience has led me to rethink this conventional view. Before I came here, I was at the University of Illinois, Urbana, where I had had a pretty conventional career as a social scientist until I got caught up in an interdisciplinary community that was interested in designing systems, deploying them, and evaluating the impact of technology on

organizations. That exposed me to a world in which I was dealing at a fairly detailed level with technology design, evaluation of user responses, and adapting technology to user needs. Because of my participation in that community I became involved in the National Center for Super Computing Applications (NCSA). And I was lucky to see what happened while the graphical web browser—Mosaic--was being developed.

Sometimes change comes from user pull, sometimes from technology push. There's no one entry point that is the *right* entry point. The thing that made that point absolutely crystal clear for me was the web browser. Because the graphical web browser was developed mostly by a bunch of people in the NCSA Software Development Group who thought that would be a really helpful and cool thing to have. There were no user studies or detailed interface design evaluations. What there *was* was something so compelling that everybody had to have it immediately. It was the original killer app. People grabbed it and it began to change and mutate and become something different because of what we were able to do with it. But its initial design had none of that. It was, in a sense, a pure technology push.

So when you have an instance like that in front of you, you start to re-think your view of technology development. In fact, there's a lot to be said for something like Internet2, which is much more of a technology push, as we've noted throughout this meeting, than a user-needs pull.

This suggests two things going on now that have to be attended to. First, we need to nurture technology development for its own sake, not undermine it. Those capabilities are what allow us to assist people to find exciting and new kinds of applications. But second, we do need to assist people in reaching the right applications. One of the things I've been working on here in the Media Union is figuring out precisely what kind of support model will allow faculty on this campus to number one, have access to the most exciting, new, enabling technologies. We've developed a two-layered support model here to both provide access to the technological capability and expert guidance on how that technology might be applied.

For me a critical part of this is developing the capability to support cross-disciplinary teams that work through the process of design and deployment together. It doesn't matter whether that kind of team starts from, "We have a social need that needs to be met," or, "We have this awesome bandwidth that we might be able to

use. What could we do with it?" The important thing is you get the right kind of dialogue going.

A second point here that I think is very important from the standpoint of promoting change is preparing ourselves and our communities to accept change just as a matter of course. And I think there are two things we can do to begin to work on this.

The first involves what I'm starting to call *exemplary technology*. And that has two senses for me, both of which I think are interesting and important. Exemplary, of course, in one sense means worthy of being modeled: wonderful, excellent, fitted to its task. And that is, of course, the fundamental value of human-centered design and community-centered design. We want technology that is exemplary in that sense: embodying a perfection of design that connects with all of our standards for appropriate support for human interaction. But there's a deeper and I think more interesting sense of the word exemplary that for me has been a way of understanding good design and technology in a new way. I have long been a fan of Thomas Kuhn's *Structure of Scientific Revolutions*, [2] which of course has been an enormously important book.

While many people have been influenced by Kuhn's discussion of scientific paradigms, the thing I liked best out of Kuhn's work was his idea of a science exemplar. The idea is that change in fundamental change in our ways of understanding the world and how to study it is leveraged by critical examples: somebody has a problem and finds a solution to it that embodies a theoretical development, a methodological development, and an application to a real empirical problem; and this solution in and of itself is so useful that not only does it become an important piece of science, but it becomes a model that we emulate, that we can apply over and over and over again.

It's in that sense of exemplary that I think one of the things we want to strive for are exemplary technologies. And again, I go back to the graphical web browser as an example of such an exemplary technology. It not only was an excellent solution to the problem it tried to solve, but it was immediately graspable and extensible and people incorporated it in a very rapid way within their own processes and cultures and local systems of practice and began doing new things with it. So everybody could figure out how to use it and somehow everybody could see new things to do with it. So we got this enormous

explosion of new applications and creative activity centered on the Web.

A second exemplary technology that is less familiar to many but is very familiar to me because of my personal history is the PLATO instructional computer system (for a history, see <http://www.xxlink.nl/plato.htm>). PLATO was one of the first on-line learning systems, designed at the University of Illinois to support network-based learning. It was very broadly used throughout the University of Illinois campus, in fact, ended up creating what I believe is a distinctive campus culture from the standpoint of the use of learning technology.

PLATO was a transformative technology in part due to was the ease with which faculty could transmit it from one to another. They used it in classes and wrote up their experiences in published reports, of which there are many. What was really interesting to me was that the list of faculty who were using that technology—so many of them have grown up to be the star senior faculty who are still on that campus. That is an index of how quickly and how importantly PLATO was diffused on that campus. A lot of it had to do with the ways in which the particular solutions that were generated using PLATO were exemplary in exactly the sense I'm talking about. Professor A in Spanish could show what she was doing to Professor B in English. And all of a sudden they had a new solution to problems in a new field. And it just spread one faculty member to the other across the campus. One of the things we need to start thinking about is how it is that technology comes to be exemplary in that way. If I knew how to help identify and/or build exemplary technologies in this sense, the problem of helping grow a community of advanced users would be greatly simplified.

Obviously a second kind of issue we need to deal with has nothing to do with the design or characteristics of the technology but rather with the communities that adopt it. Here we need to think very carefully about issues of education and access—not just providing access to what we have now, or education for what we have now, but education for change. I'm not going to belabor this point, but obviously in order to do that we're going to need to understand what allows a person to be an early adopter, what allows them to respond to changes in a positive way and become life-long learners.

A third topic that's important from this standpoint is the topic of managing change. Obviously we don't want to just promote change.

As change occurs, we want to do what we can, as the last speaker suggested, to help manage that change in a positive way. There are a number of things that we need to consider as we attempt to exercise some direct management of these kinds of change processes. The first one is a point that, Peter Monge has made frequently: when we're dealing with dynamic and self-organizing processes there is a limit to what you can do in the way of managing change. And I think Scott Poole's talk on adaptive structuration approaches also emphasized that issue. There is a certain point at which what happens with technology is a matter of the local context and how things get played out at that local context, at that point in time

That's an important fact about the way an institution will self-organize. And it's something we just have to take into account in terms of setting the limits on what we can aspire to in trying to manage change. But there are some things that I think we can do -- and especially as we form partnerships between technologists and social scientists to move forward here.

First, we can be much more aggressive at monitoring change. I think the social science community tends to rely on individual interest and motivation to generate data about large-scale technology change. There needs to be some kind of systematic umbrella approach to really keeping track of what's happening so that, for one thing, people who are designing technology will know what the capabilities are out there that they can design to and what they aren't. This is very important to begin to take the pulse of the social system.

Second, I think we need to begin to understand much more deeply processes of adoption, appropriation, and diffusion. And obviously I think this is an absolutely critical topic for the research agenda right now. It's not a brand new topic. It's been studied it for many years in a number of disciplines. But I think it's an area where we would be well advised as a to begin making some major investments in continuing development of research. Research on diffusion of innovation bloomed for a while, then kind of stalled a little bit. Now we're getting some really interesting new lines of research going -- and I've mentioned some of the ones that I particularly admire. But I think this is a point in time where that needs to be a critical part of the research agenda.

One final topic related to change -- the importance of resistance to change. We know that not everybody responds the same way and

not every culture responds the same way to new opportunities. And this has been a theme that we've heard over and over again throughout the summit. Understanding resistance to change--where it happens and how it happens--is going to be a critical part of the overall picture here. Here we need to understand how individuals relate differently to new developments; differences in personality, education, and values connect to the use of opportunity. We need to understand differences in access, which result from economic differences. We need to understand the resistance of social systems to change, the fact that they are ongoing networks with bonds of relationship and existing norms and structures that have their own inertia.

I think the response to all of this is for us to make common cause to address these issues of technology change and understand them. This will involve two things: building a research agenda and building a research community. If we fail to draw on the existing disciplines we will have failed to do what we need to do to build a research agenda. As you know from my introduction to Panel V, *Collaboration and Work Groups*, I think there's been far too little attention to relevant but fragmented bodies of existing research literature. I think an important investment for us to make as a community and for our federal agencies and foundations to make is in a concerted effort at research synthesis designed to deal with these issues.

I hope that out of that synthesis and out of our ongoing dialogue with each other we'll be able to identify a set of key problems and issues to focus on. But I think some of the ones that are mutually exciting to all of us are easy to identify from this meeting:

- real time collaboration and conferencing;
- visualization;
- real time use of large digital libraries

To the extent that we find problem areas like these, we will find a good way to bridge between our many different interests.

A second thing we need to attend to is building a research community, which is something that takes, as we all know, a lot more work than just identifying an agenda for research. Here we need to spend, as other speakers have pointed out, a lot more time developing a rich base of mutual knowledge--not just common knowledge, but in Herb Clark's sense, mutual knowledge [6]. We need to know what the other person knows, what we can assume about the other person that we're dealing with. And we need to know that

they know we know it. That way when we talk together we have some confidence that we have a reasonable amount of understanding. And the only way to build that mutual knowledge is to have enough interaction to know enough about the other person's background that you can make reasonable inferences, or even better, to have direct knowledge of what that other person is about. I think all of us are hoping that the outcome of this meeting will be a motivation on the part of the whole community to make that kind of personal investment in building a shared context for communication and collaboration.

A second thing that we haven't talked about much, but that I think is really critical to the development of a research community, is development of test beds in which we agree that we can see the phenomenon that we want to work on and study. We've seen some interesting examples of emerging test beds that use high-performance computing and networking. And you saw those in the demos out here at the summit. Those included things like space physics, the SPARC collaboratory, the tele-medicine applications, and various kinds of distance learning applications. As a community we need to not only identify but also begin to work to develop additional test beds that help us generalize beyond what we've already seen.

Finally, and this I think is absolutely critical, we need to start responding to the need for methodological development in this area. Again, consider the example the Mosaic web browser. One of the great regrets I have in my scholarly career comes from a meeting that I went to at NCSA sometime in 1993. Joe Hardin, who by odd circumstances is now the Deputy Director of the Media Union, was, at the time, the Software Development Group's director and he invited me and a bunch of other Illinois faculty over to NCSA to see a cool new thing they had just developed. He showed us the web browser, which hardly anybody else had seen yet, and said, "Hey, we've developed this and a small community of scientists can't get it fast enough. They're down loading it like crazy. We don't know what's going on. Can you help us figure out in the next week how to study this so that we can get some information about the diffusion of the web browser across the country and around the world?" And everybody scratched their heads and said, "Gee, you know, if you'd give us six months we could come up with something." We don't have six months anymore. We're never going to have six months again to solve those kinds of methodological problems. We

have to be prepared as a community with flexible methods to anticipate changes that give us the capacity and the frameworks to respond to new developments. We need to think about these methodological needs. And we need to do it as a community and begin to disseminate these frameworks so they're ready to hand when opportunities present themselves.

I'm going to draw to a close now-- thank you very much for coming here to visit us. The Media Union staff and I were pleased to host this summit. We're glad you came and we hope you had a good time. Thanks a lot.

References

- [1] R. Kling, Rapporteur, Panel V: Collaboration and Work Groups, *Internet2 Sociotechnical Summit*, Ann Arbor, MI, 13-15 September 1999.
- [2] T. S. Kuhn, *The Structure of Scientific Revolutions*, 3rd ed., University of Chicago Press, Chicago, IL, 1996.
- [3] C. Marvin, *When Old Technologies Were New: Thinking About Electric Communication in the Late Nineteenth Century*, Oxford University Press, New York, NY, 1990.
- [4] W. R. Neuman, Panel VI: The Socio-Policy Context, *Internet2 Sociotechnical Summit*, Ann Arbor, MI, 13-15 September 1999.
- [5] M. S. Poole, Panelist, Panel V: Collaboration and Work Groups, *Internet2 Sociotechnical Summit*, Ann Arbor, MI, 13-15 September 1999.
- [6] H. H. Clark, *Arenas of Language Use*, University of Chicago Press, Chicago, IL, 1992.