Organizational Communication and Designing Cyberinfrastructure to Support Science and Emerging Groups

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ABSTRACT

In this paper, I take an organizational communication approach to examine issues that can influence the design, adoption, and implementation of cyberinfrastructure to support science and emerging groups. A preliminary analysis reveals that the history of the field with the Internet and computer technologies, the agenda of the funding agency, and the competing theories and methodologies held by participating scientists and groups are three such organizational communication issues. By presenting these issues in the form of questions, the author seeks to provoke a discussion at the workshop about these issues' relevance (or lack of) to the design of cyberinfrastructure to support science and emerging groups.

Author Keywords

Organizational Communication, Adoption and Implementation, Emerging Groups.

ACM Classification Keywords

Cyberinfrastructure, Computer Supported Cooperative Work.

INTRODUCTION

Cyberinfrastructure (CI) refers to a collection of information, communication, computer technologies and human experts [1]. Dan Atkins et al., [1] explain that in the 21st century science, CI includes "the integrated electro-optical components of computation, storage, and communication, … software programs, services, instruments, data, information, knowledge, and social practices applicable to specific projects, disciplines, and communities of practice, … hardware, algorithms, software, communications, institutions, and personnel" (p. 5). In other words, cyberinfrastructure represents the collection of machines and humans, as well as the social interactions and organizational practices surrounding the meshing of the two. The implementation of CI is inherently social and organizational. A conversation about the design of CI to support science can include an examination of the social and organizational issues related to the design and adoption of CI in practice.

One approach to examine the social and organizational issues related to the design, adoption, and implementation of CI is to employ the lens of organizational communication. An organizational communication approach treats communication as a way to explain the production of "social structures, psychological states, member categories, knowledge and so forth rather than … simply one phenomenon among these others in organizations" [2, p. 5]. An organizational communication approach emphasizes the process of organizing through symbolic interaction [3]. In this position paper, I attempt to identify a few organizational issues related to the design, adoption, and implementation of CI by taking an organizational communication. In doing so, I highlight three organizational issues that communicate influence to the design of CI. This brief position paper is based on three excerpts drawn from a data set of 48 interviews with research scientists and engineers, supercomputer center administrators, computer and computational scientists, principle investigators, social scientist and policy experts in Texas, California, Illinois, Pennsylvania, Ohio, Michigan, Indiana, Louisiana, and Washington DC. I present the preliminary findings in terms of questions to be asked as we design CI to support science and emerging groups. I will present these questions in the following paragraphs.

FIRST QUESTION

The first question asks, "*What is the field's history with the Internet and computer-supported cooperative* *work?*" The Internet, computers, and a wide range of emerging information and communication technologies shape today's organizational life [4, 6, 7]. Every scientific field has a history with the Internet and computer technologies at work. This history will affect how scientists in a field approach CI, and how CI design will impact their work. The younger the field, the more receptive the scientists and emerging groups will be to doing computer-supported cooperative work on CI. As an interview participant shares,

> [L]et's take bioinformatics [as an example]… The use of the Internet to do the science is dominant. That's very different, say from chemistry… Because the field is much older… If you look at biology versus chemistry, there are dramatic differences in the field, in the nature – everything in biology is pretty open, as far as I know. It is all put on the Internet. And chemistry – nothing is open and almost nothing is put on the Internet… I think it mostly reflects history… Chemistry was born a very long time ago. The electronic support was born 30 years ago. It is inconsistent with the Internet cyberinfrastructure model. Whereas biology, bioinformatics, was born 10 years ago. So it grew up as the Internet was growing up. So biology almost started doing cyberinfrastructure without thinking… That field is richly cyber-enabled…. Science is evolutionary... If the previous step was on the Internet, the next step probably has to be on the Internet, by definition. So you're not able to not do cyberinfrastructure." (Professor of Informatics, Professor of Computer Science, and Professor of Physics, Indiana).

As we examine the issue of CI design to support science and emerging groups, we need to distinguish among the different disciplines of science, and take into consideration a field's history with the Internet and computer technologies. Scientific practices within a field are shaped by its history, and these practices can only change by slowly evolving over a long period of time. The design of CI should closely match existing practices, if CI is to be adopted and implemented to support a particular branch of science. Compatibility [5] with existing practices is key.

Furthermore, an effective design for one field may not be equally useful for another. Different fields developed their unique ways of doing science, and these organizational practices rooted in past successes are difficult to change. The design of CI to support science has to acknowledge the complexity and diversity in a wide range of disciplines and fields in science. If we need to build more CI to support different branches of science, funding is a key organizational issue to consider next.

SECOND QUESTION

The second question to consider asks, "*Who is funding the CI project, and which agenda is the project advancing?"* Although science is often assumed to be a neutral endeavor simply to improve human conditions in the society, the organizational influence associated with funding agencies behind the scene is not neutral nor value free. Funding agencies only fund projects that promote and advance their missions and agendas. If an agency is to fund a particular project, the money is given only to conduct science relevant to the agenda of the funding agency, and not the agenda of another. Below is what a policy expert reveals,

> "In some cases, in larger institutions, the problems are really magnified by the fact that faculty receives grants from NIH and other places, which did not encourage collaboration and joint usage of technology, but rather, waived them off and said – If you go out and get a Sun workstation on your desk, put a couple of Condors together, and then when the funding runs out, you're left with this big bill to run these machines… if it's [the funding is] going to be used for anything other than the research you did initially." (Policy Expert, Washington DC)

Funding is perhaps the most powerful driving force behind large-scale science in the US. A CI project is very expensive, and without funding from agencies such as NSF and NIH, no CI can be built. These funding agencies allocate resources to CI projects on a limited term basis. Once the allocated funding is used up, and if the project cannot secure continuing support, the operation comes to an end, including the development of CI for the project. In addition, the agenda of the funding agency influences the design of CI to prioritize activities in scientific research. What does not serve the agenda does not get built into the design.

Furthermore, funding is not neutral. By receiving funding from a particular agency, acceptance of the agency's agenda is implied. Therefore, while discussing the design of CI to support science and emerging groups, it is important to keep in mind the political priorities communicated through funding to a particular project. If a CI project is to continue, the project has to continue advancing the agenda. The development of CI is not only closely aligned with the funding agency's agenda, the design of CI is also closely tied to the theoretical and methodological competitions within a field. This observation turns us to the third question.

THIRD QUESTION

The third question asks, "*For which theory or method is the CI built?*" There are competing theories and methodologies within any disciplines and fields in science. A vibrant scientific community engages in a healthy debate about the different ideologies and approaches to doing science and emerging groups. However, when it comes to the design of CI to support science, we inevitably encounter the competition among these different groups of scientists who hold different philosophies of science. As the last informant in this position paper points out,

> "We've been in disputes with people essentially having two different – not quite theories, but two methodologies to approach a problem. They would come to the cyberinfrastructure folks and say – We're glad to be on the project and of course you're going to include my methodology in the way the software works and exclude my competitor over there." (Supercomputer Center Administrator, Illinois)

The decisions made before and during the process in which CI is designed to support science and emerging groups involve persuasions, arguments, or even conflicts between groups. The theory or methodology selected to guide the design of CI determines which theoretical and methodological camp gains ground in advancing its approach to science. Scientists compete to influence CI design in favor of their own orientation, and persuade computer and computational scientists to write codes and build applications that will support their method. This is a process to indirectly weed out competing theories and methodologies in the field. The design of CI becomes a contested terrain among competing groups of scientists.

CONCLUSION

In this paper, I attempted to employ an organizational communication approach to highlight three organizational issues that could affect the design of CI to support science and emerging groups. Through preliminary analysis of selected excerpts from a larger interview data set, I presented three questions to consider while designing CI. The three questions include: "*What is the field's history with the Internet and computer-supported cooperative work?*"; "*Who is funding the CI project, and which agenda is the project advancing?";* and "*For which theory or method is the CI built?*" These questions reveal that the history of a field, funder's agenda, and theoretical/ methodological commitment of scientists can influence decisions that go behind the design of CI to support science and emerging groups. A few implications can be drawn from these observations. I will discuss them in the last paragraph.

First, given the limited resources to build CI, the design of CI is best to be flexible in order to adapt to a wide range of scientific fields. When there are discipline specific requirements, parts of CI can be built to cater to these needs. Second, while it is important to bring older disciplines on board with CI, perhaps a good approach could be to focus on younger fields in order to create a critical mass in the overall scientific community. A critical mass naturally helps speed up diffusion and adoption [5]. Third, CI projects may benefit from staying with one primary funding agency, or closely allying agencies, as trying to satisfy different agendas simultaneously or subsequently is difficult, especially when (re)building CI can be extremely costly. Fourth, CI design may best be neutral by creating a platform through which competing theories and methodologies can be tested on equal ground.

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