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Final Design Proposal

Collaboratories:
Building Online Tools to Enhance Scientific Research Collaborations

Design Problem

The target group for this design proposal is a major research project focused on clinical trials for a new vaccine to combat the HIV/AIDS pandemic. The research teams are distributed among several research institutions all over the world. Each team is focused on a slightly different aspect of the research problem but on the same overarching goal. They want to work together and share best practices and administrative tasks such as procurement and fund disbursement, as well as stay current on each other's research progress. They also want to leverage the expertise of the group's members to solve problems internally rather than bringing in outside consultants.

The key stakeholders in this process are the users themselves: the research teams. But project administrators and funding agencies also have a large stake in ensuring these collaborations are successful.

It's one thing to collaborate with the researcher down the hall, but what if one's collaborator is thousands of miles away, speaks a different language and maybe hails from a different scientific discipline? Based on current Information Behavior (IB) and Human-Computer Interaction (HCI) research, I have developed a design proposal for an online collaboration tool to support the work of biomedical research teams working on a global research project. In this paper, I will discuss the IB of scientists and the nature of scientific research collaboration, as well as some of the barriers to creating online collaboration tools to support these endeavors.

How Scientists Work

Long gone are the days of the mythical lone scientist plugging away for years, alone in his basement laboratory. For a variety of reasons, today's scientific research projects are increasingly collaborative. First and foremost, science is increasingly complex and few can make significant progress without collaborating. Scientists are more specialized than ever before and need to collaborate to get a bigger-picture view. Second, high-tech scientific tools are so expensive that researchers must spread the cost out over many institutions. Also, government funding agencies are demanding that scientists collaborate in order to get the funding they need (Katz, 1997).

One consequence of this increased collaboration is that scientists are working with others from different fields. Each of these fields has its own culture and epistemology, making collaboration a challenge. Chemists and physicists have very different approaches to problem-solving and speak different languages. Clinical trials bring together physicians and basic scientists who have little understanding of the work the others do. This is compounded by the fact that science and medicine are very international fields, with

professionals hailing from all over the world. Finding ways to bridge those differences is crucial to a successful collaboration.

The field of scientific research is highly competitive. As government funding for science has dwindled and the cost of research has increased, competition for money is fierce. As many researchers are working on similar problems, credit for discoveries goes to the first to publish their results. The more a researcher publishes, the more funding she gets (Katz, 1997).

Information Behavior of Scientists

The field of Information Behavior covers how users need, seek, manage, use and share information. The IB of scientists has been heavily studied throughout the history of information science research. Government funding was plentiful for such studies, as it sought to increase the productivity of scientists in the post-WWII era. For our purposes, the most important points about the IB of scientists are:

- Scientists rely heavily on their social networks for information
- Scientists have a strong need to stay current on ongoing research in their fields, both to inform their own research and to aid in their efforts to publish as frequently as possible
- Scientists rely heavily on electronic journals, conferences and pre-prints to stay current in their fields
- Within their trusted networks, scientists share information extensively

Many of the theories of IB apply to scientists. First, Marcia Bates's Berry Picking model details how searchers gather facts along the way, constantly refining their search terms and targets. Scientists work this way as they research, constantly gathering new facts, testing and discarding or assimilating new theories (Bates, 1983). Brenda Dervin's Sense Making theory also applies to the IB of scientists. Science is all about noticing a gap and trying to make sense of it through information seeking and assimilation (Dervin, 1990). The way that scientists rely on their social networks both for information and for collaboration sources relates to Elfreda Chatman's theory of Small Worlds" (Chatman, 1999). In a study on the IB of professionals, Leckie et al commented, "…rather than being remote, impersonal, and rigid, scientific research was actually communal, reflecting a strong interpersonal network of interconnected scientists. It was also been shown that in these networks there were both formal and informal channels for information exchange and that frequently scientists themselves considered the informal channels to be equally or more important than the formal in their information seeking" (Leckie, 1996).

While there are plenty of studies of IB of individual scientists, especially in the areas of information needs and information seeking, there is little research on either the IB of scientists working as groups or on how scientists manage, use and share information. These are areas that need significantly more research.

Scientific Research Collaboration and Collaboratories

The phenomenon of scientific research collaboration has been studied extensively, though remains poorly understood. Defining what exactly constitutes a collaboration is tricky. Is it a casual conversation in a hallway that leads to a new research direction, or does it require a substantial contribution of time and resources? Who can be considered a collaborator? Generally graduate students are not considered as true collaborators until they have been granted their PhDs, despite possibly making significant contributions (Katz, 1997).

Most collaborations are born of existing social connections, "begin informally and are often the result of informal conversation [which then leads] to increasing commitment to co-operate" (Katz, 1997). Scientists tend to collaborate most frequently with people they already know, either from graduate school or a previous job. This speaks to a level of trust necessary to collaborate successfully. Scientists also tend to collaborate with researchers who are geographically proximate, as this simplifies the process of coalescing as a collaborative unit. Easier access means casual conversations are more frequent, keeping researchers on the same page in terms of their research. Misunderstandings are fewer as researchers can communicate face-to-face and utilize social cues missed out on by technological communications. Trust is more easily developed when people are interacting in person (Gallie, 2005).

There are great benefits to collaborating on research. Researchers are able to take advantage of each other's skills and knowledge, learn new skills and methods (especially tacit knowledge), challenge their own thinking by collaborating with scientists with different viewpoints and backgrounds, work with others who are passionate about the same interests, gain new contacts, and potentially gain greater visibility for their work (Katz, 1997). As with any social construct, there are also possible costs. These could include additional expenses when the team size increases or when travel is necessary, an increase in the time needed to do the research due to increased negotiations over meaning and results, increased administrative needs and costs and reconciling different cultures if the collaboration involves more than one entity such as a university or research center. (Katz, 1997).

There are areas of this process where technology can help and areas where it not only cannot help but might actually hinder the research process. Where the knowledge that needs to be shared is explicit, meaning that it can be clearly written down and codified, communication by online tools can work beautifully. However, when a discussion needs to take place that revolves around tacit knowledge, that which cannot be easily codified, electronic means are less than ideal. When ideas and results need to be hashed out, defined, and clarified, face-to-face communication is still better, as it allows for non-verbal communication to take place, as well. It's simply easier to iron out confusion in person (Gallie, 2005). One way to combat this in an online tool is through the use of forums where differences can explicitly be ironed out through in-depth discussions. Kouzes advocates for "…support for the discussion of unfamiliar concepts so that misunderstandings can be corrected" (Kouzes, 1996).

Collaboratories were defined by Kouzes as "…laboratories without walls" and used to explain the concept of collaborating across institutional, geographic and disciplinary boundaries. Numerous research studies have been funded to try to create a framework for building collaboratories. Thus far, this has not been successful. This is due to the fact that each research collaboration is unique and requires its own set of tools to manage the collaboration. Each project has its own set of data, its own set of processes and procedures and its own unique social structure. One size does not fit all (Schleyer, 2001). And yet, some basic requirements can be defined.

Online Collaboration Tools

Given this overview of how scientists collaborate on distributed research projects, how can we design tools that not only support their research but actually contribute to it and enhance it?

First and foremost, the users of the tools need to be intimately involved with their development. Through the use of participatory design or iterative, user-centered design, researchers themselves will need to help tool designers understand what will make research easier and more productive. Designers need to take the time to really understand the research process, especially how clinical trials work, and understand the tasks that researcher teams need to accomplish. Workflows need to be understood and confirmed through observation. Throwing technology at users without first ensuring it will meet their needs will not be successful.

Following are a few basic requirements for any tool that aids online scientific research collaborations. The observation methods detailed above will likely yield more requirements, as well as greater detail.

Researchers will need the ability to:

- **Share documents.** Researchers will be collaborating on papers, schedules and protocols. Emailing versions quickly turns into a nightmare of revisions and comments and does not scale well to a large group. A tool that allows for versioning of a document is crucial.
- **Access group news and research summaries from other sites.** This is one of key elements to forming a cohesive group of researchers. Having a thorough understanding of what other members of the collaboration are doing is fundamental to maximizing the benefit of collaboratories. One possible implementation of this is weekly or monthly blog entries by key researchers on each team that are highlighted for others to read.
- **Access up-to-date research in the HIV/AIDS field and science in general.** It is virtually impossible for any scientist to keep up with the research literature in his own specialty, let alone the breadth of science and industry. The field of knowledge management teaches us that innovation generally comes from applying established ideas from one field to problems in a different field. In order for scientists to do that, they need to stay current. Carefully selected articles, perhaps with summaries and/or annotations, can aid researchers without overwhelming them.

- **View calendars of events for their own groups, the research project and the HIV/AIDS field.**
- **Share tips and tricks**. Research teams need to leverage the knowledge within their organization by sharing this type of information about both the online tool itself and their research methodology.
- **Find expertise within the group.** As discussed above, scientists rely heavily on their social networks when seeking information. Being able to look at a team roster allows researchers to extend their social network and quickly locate someone who might have the expertise needed to solve a problem. This can save a significant amount of time as well as possibly leading to new collaborative relationships and new, innovative ideas.
- **Use metadata to organize and search.** The amount of information generated by and required by research projects is staggering. Researchers need to quickly locate the information they need without spending hours searching. "One report from the Boston Consulting Group suggested that $200 million and two years could be shaved off a drug's development time by using informatics effectively. Other reports … suggest[ed] that 20 to 40 percent of total time spent on a typical proteomics project is wasted on searching for appropriate information" (Larsen, 2005). Clear, concise metadata and a strong, intuitive organizational structure can help with these issues.
- **Utilize a controlled vocabulary for metadata.** In order to maximize the benefits of metadata, a controlled vocabulary needs to be implemented. Based on the information needs of the team, lists of terms, much like tags, will be available for use. This will need to be managed by the site administrator to ensure clarity.
- **Train new employees.** As new members join the research team, they need to get up-to-speed quickly and not drain the resources of the rest of the team. A robust portal can help in this area by pointing new employees to existing information such as previous research, current projects and other resources.

Why Microsoft SharePoint?

I have chosen to use a SharePoint 2003 portal as a demonstration site for several reasons. The Microsoft interface is familiar and mostly self-explanatory. It simplifies the building of a portal by giving the administrator pre-packaged tools that can be somewhat customized through adjusting GUI elements. One of the key elements that makes SharePoint a good choice for a collaboration tool is its heavy availability of metadata and an administrator's ability to customize that metadata. This enhances the research team's ability to retrieve the information they need. SharePoint also integrates with existing MS Office tools and, given its Microsoft look-and-feel, will possibly encounter less resistance than a less familiar-looking tool.

One of the barriers to the development of online collaboration tools is that each collaborative effort is unique. Each team will have different information they're managing and sharing. SharePoint allows a team to customize their tool without having to take the time to develop the underlying architecture. There is also the possibility of site administrators developing custom "web parts," SharePoint's term for each of the various available widgets, to meet the needs of the team.

Implementation

In order for this to work, several issues need to be addressed. These include motivating users to actively utilize the tools, how the online community will be managed and how success will be measured.

How can we motivate research teams to use these tools? Unless users have a clear understanding of the benefits of change, they will inevitably be resistant. Forcing users to migrate to a new tool is a recipe for disaster. Users need to be motivated through education, incentives and stories about benefits. If a user-centered approach to designing the tools is followed, by the time the tool is ready to be deployed, users will likely already have a strong understanding of what the tool is and how it can help them. But more education never hurts. Users need to feel comfortable using the tool and understand its capabilities. This generally requires training sessions, as well as constantly available help. Even after the tool has been implemented, education about more advanced features should continue.

Often the benefits to using the tools are themselves incentive enough for users to adopt new technologies. But for a tool to be truly successful in enhancing the collaboration process, incentives need to be aligned with the goals of the organization. In this case, the organization wants researchers to spend part of their time sharing existing knowledge and creating new knowledge on the web portal. The reward structure needs to acknowledge this. Performance reviews need to take into account how much an employee has contributed to the portal site. Simply expecting the users to spend time contributing and utilizing the site without reducing their other duties or rewarding them for the extra time will create bitterness and animosity toward the portal.

Someone needs to manage this online community, ideally someone with a strong understanding of the technological issues, the research issues and the information issues. The success of the portal depends, in large part, on its ability to present well-organized, easy-to-find, highly searchable information. If allowed to self-manage without proper policies and procedures in place, information will be organized in a haphazard fashion, negating many of the benefits of creating a structured information system.

The organization will need to define what it means for this portal to be successful. Is it an increase in communication among team members? Is it researchers spending less time searching for information? Is it a general feeling of team satisfaction with the tool as evidenced by frequent surveys?

Finally, the online tool needs to develop its own culture and its own shared sense of place. It needs to be a pleasant place that users want to spend their time. It needs to be a place where they can get the information and tools they need to accomplish their tasks. It needs to be an indispensable tool.

Bibliography

Chatman, Elfreda A. *Journal of the American Society for Information Science*. Mar 1999. Vol. 50, Iss. 3; p. 207.

Dervin, B. (1983). An Overview of Sense-Making Research: Concepts, Methods, and Results to Date. Presented at International Communication Association Annual Meeting, Dallas, TX, May 1983.

Katz, J. S., & Martin, B. R. (1997). What is research collaboration? *Research Policy, 26*(1), 1-18.

Kouzes, Richard T, Myers, James D, Wulf, William A. *Computer*. New York: Aug 1996. Vol. 29, Iss. 8; p. 40

Larsen, Christopher. Biopharm International. Duluth: May 2005. Vol. 18, Iss. 5; p. 32.

Leckie, Gloria J, Pettigrew, Karen E, Sylvain, Christian. *The Library Quarterly*. Chicago: Apr 1996. Vol. 66, Iss. 2; p. 161.

Gallie, Emilie-Pauline, Guichard, Renelle. *Economics of Innovation and New Technology*. Chur: Sep 2005. Vol. 14, Iss. 6; p. 517.

T K L Schleyer. *Journal of Dental Research*. Houston: Jun 2001. Vol. 80, Iss. 6; p. 1508.