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ABSTRACT

Virtual teams are commonplace today and their evolving use continues to raise a variety of interesting research questions. One specific type of virtual team is the interdisciplinary team, where team members have very different backgrounds on a variety of dimensions. A central challenge in such teams is achieving shared understanding to identify and move forward on new initiatives. We describe an initial concept and study for investigating technology and process structures to help members of an interdisciplinary virtual team identify and engage in new initiatives. We propose the concept of a "virtual foyer" as a mechanism by which team members can congregate around new ideas. The prototype implementation of the concept is described along with implications for further development and research.

Keywords

Interdisciplinary, virtual teams, awareness, shared understanding.

INTRODUCTION

The increasing use of interdisciplinary teams and continuing development of collaboration technologies (CTs) create both an opportunity and a need to examine how CT capabilities can best support interdisciplinary teams. Members of interdisciplinary teams may come from different organizations, locations, time zones, cultures, or any of several other potential discriminators. Despite their differences, however, team members need to find a way to come together quickly and easily to work on initiatives of interest. Although increasingly more complex CT capabilities are being developed, complexity does not always go hand-in-hand with user acceptance (Qureshi and Zigurs 2001), so it is important to find the "balance point" at which usefulness and simplicity intersect. This need is especially salient for diverse teams whose members may have substantial variation in technology skill or comfort levels, as well as diversity of perspectives and opinions.

This study focused on the introductory phase of forming an interdisciplinary virtual team around an initiative. We worked with the Institute for System Science (ISS), a pseudonym for an interdisciplinary organization representing six colleges at a medium-size university. The ISS was formed to be a place where faculty and students could work in teams with local and international groups and organizations to conduct original, interdisciplinary research and develop methods and technologies to advance their field. ISS members participated in the definition of requirements and testing of the prototype for the study.

We define an initiative as any project that a member of the ISS starts and one or more other members choose to join. We introduce the concept of a "virtual foyer" as a time- and location-independent gathering place that allows people to converge around shared interests and develop a sufficient

understanding of those interests to allow them to move into the next step of actually working together on the initiative. The research question is: *What technology and process structures are appropriate for helping members of a virtual interdisciplinary team to identify and engage effectively in a new initiative?*

This research is important for several reasons. First, as organizations face increasingly complex and nuanced problems, success demands answers built upon integrated perspectives. Interdisciplinary teams provide just such a perspective. Second, members join an interdisciplinary team with significantly different technical abilities and views of technology. Selecting the capabilities that are most appropriate for different tasks gets even more complicated when one considers the expanding use of and options within CTs. Teams need better guidelines for making those choices. Finally, the appropriate type and level of structure for CTs must also be studied if we are to provide an environment where all members can contribute without being burdened with overly complex capabilities or choices.

Our study is designed to address these needs. What makes the project unique is the intersection of divergent perspectives with expanding technology options and the concomitant need to find a common interest point for a team to be able to move forward in collaboration.

CONCEPTUAL BACKGROUND

Several important issues are raised within the context of our research question. Those issues relate to the nature of the team, the development of awareness and shared understanding, and the match of technology with task. We briefly review key points on each of these issues.

Virtual and Interdisciplinary Teams

The focus of this study is ad hoc, project-specific teams formed to handle short-term initiatives through the use of CTs – the very definition of a virtual team (Powell, Piccoli et al. 2004). Virtual teams offer organizations a way to dynamically adjust to changing needs such as fast-breaking short-term assignments or the need for specific expertise on a particular assignment (Jarvenpaa and Ives 1994). For some assignments, the nature of the task(s) being addressed will require expertise from multiple diverse disciplines. If heterogeneous groups are going to benefit from including different disciplines on a team, they must consciously integrate knowledge from those disciplines or they risk isolating the team from skills, knowledge, and perspectives that may be useful (O'Donnell and Derry 2005). Groups in which individuals possess diverse knowledge can benefit from a social exchange of ideas to a greater extent than groups with more homogeneous knowledge across members (Brown and Paulus 2002). Enhanced social exchange in team settings provides opportunities to clarify meaning and terminology that may not be clear across disciplines, as well as allowing for increased integration of concepts among disciplines (Brown and Paulus 2002). This heightened need for social exchange in interdisciplinary teams was a key consideration in how we crafted the prototype for this study.

Awareness and Shared Understanding

Once a need for a virtual team has been established, it is important to allow that team to develop an understanding of the task at hand while also building some degree of social identity (Powell, Piccoli et al. 2004). The composition of a virtual team and its patterns of interaction have a strong influence on how a team builds the shared understanding that is crucial to its success (Powell, Piccoli et al. 2004). Being aware of what teammates are doing and what information they have to contribute to the team effort are crucial first steps in building shared understanding of an initiative (Davis and Khazanchi 2007). Within the computer supported collaborative work community, awareness is defined as an understanding of the

activities of others that provides a context for one's own activity and coordinates group activities (Dourish and Bellotti 1992). The mechanisms to automatically provide awareness can take several forms, including automatic email alerts whenever something in the team workspace is changed or visual cues whenever someone is "in" the workspace.

A particularly important aspect of shared understanding is developing a common language for communication (Majchrzak, Rice et al. 2000). With that common language in place, the virtual team can explore and define the boundaries of the problem and determine how different team members can best contribute. In fact, establishing this level of shared understanding has also been shown to allow teams to complete more ambiguous tasks (Majchrzak, Rice et al. 2000). For virtual teams, the core communication capabilities of CTs are critical in supporting the development of this common language. This shared understanding can be further enhanced through incorporation of other "background" information germane to the team's assignment (Suchan and Hayzak 2001). An example of this approach would be developing a repository for team documents that contains contact information, project schedules, and detailed project descriptions. The ultimate aim of nurturing this shared understanding is to establish a shared mental model of the task so that team members have a similar view of as many aspects of the task as possible.

Achieving the benefits of adequate shared understanding can be difficult, however. The nature of communication through CTs can make the electronic discussion longer and more confusing than simple face-to-face communication (Bordia 1997). Moreover, if the team chooses to use a particular CT that presents problems for some team members, those problems can detract from performance and satisfaction with the team process (Kayworth and Leidner 2000).

Task-Technology Fit

Collaboration technologies play a crucial role in supporting virtual teams by allowing teams to bridge the very gaps that make the team virtual (Jarvenpaa and Ives 1994). At the heart of the Task-Technology Fit (TTF) approach is the notion that there should be a "fit" between the work a group must do and the tools the group chooses to complete that work.

A group task can be defined as "*the behavior requirements for accomplishing stated goals, via some process, using given information*" (p. 316) (Zigurs and Buckland 1998). This view of group tasks cleanly separates the task from any specific form of technology and instead focuses on what behaviors are required to move the group closer to its stated goal(s). Implicit in this definition is the notion that there are multiple ways to arrive at the stated goal(s). Extending this idea, one could view that set of behaviors as a performance profile and then think about the degree to which any CT fits the profile (Zigurs and Buckland 1998). DeSanctis and Poole (1994) described a similar idea when they talked about individuals using process structures (i.e., rules and organizational norms and resources) in on-going interaction with technology to complete group tasks.

Part of the TTF challenge is to identify the behaviors that the technologies need to support and then select the most appropriate technologies to provide that support. In doing this analysis, there are likely multiple tool options to support each individual way to arrive at a goal. This is especially true now given the evolution of CTs, which are often viewed as bundles of capabilities (Carte and Chidambaram 2004). Together, the "profiles of behavior" and "bundles of capabilities" concepts more accurately reflect the range of behaviors in which groups routinely engage as well as the range of technologies available with any single product choice to support those tasks.

Analysis and Integration of Conceptual Background

The vision for the "Virtual Foyer" is to provide an infrastructure of technology and process capabilities for interested members of an interdisciplinary group to "swarm" around a potential new project and to do so quickly and easily. Because the ISS is itself a virtual organization, the research teams formed to address new projects are expected to operate virtually. Furthermore, given that the ISS is composed of researchers from six different colleges, we also expect that these teams will often be interdisciplinary.

To get started effectively, members of these research teams first need to be aware of new initiatives and then have the opportunity to investigate them through dialogue. The virtual foyer should provide a forum for ISS members to become aware of each other's interests and availability, and through dialogue and artifact sharing (e.g., document files, spreadsheets, or drawings), members can develop a shared understanding of the initiative and a common language to discuss it. Once an initiative takes shape, the interested sub-group can move in a direction that capitalizes on the expertise and willingness of its specific members.

This process of establishing awareness and developing shared understanding in a virtual context – the profile of behaviors inherent to ISS teams – is what drove the selection of an appropriate technology platform – multiple discrete technical capabilities bundled into a single package – for this study. The following section describes how that selection process unfolded and how the discrete capabilities were configured to support the ISS.

PROTOTYPE AND INITIAL CASE STUDY

Requirements Analysis

One goal for establishing the ISS was to provide a formal structure that would support a collaborative environment in which members could identify and engage in new initiatives; thus, the ISS is a natural site for this particular study. We solicited requirements from ISS members by asking them how they currently find opportunities for involvement in initiatives; how they would prefer to find those opportunities if there were no constraints on communication or technology; what specific information they use to decide whether to engage in an initiative; the format of that information; and any other suggestions they might have. The questions were posted for the 15 inaugural ISS members in the Virtual Foyer discussion forum for 3 weeks. Table 1 shows the requirements that were extracted from the responses.

Additional selection criteria emerged through meeting with the Institute's staff. First, given the broad range of technological sophistication in our user group, the CT needed to have as familiar an interface as possible and also have a minimal learning curve. Furthermore, the ideal technology should not require additional client software to be installed on each member's system, and it should sustain itself with minimal upkeep. Essentially, the ISS wanted to have the lowest possible cognitive load on users and the least workload on its IT staff. For these reasons, we chose Blackboard for the pilot implementation because it was already installed and used throughout the university, it could be configured to meet the majority of the potential users' requirements, and it fit the additional considerations of the Institute's IT staff.

Prototype

The heart of the Blackboard implementation of the Virtual Foyer is the Discussion Board feature. Every member of the ISS has privileges to post and respond to discussion topics. Furthermore, the system is configured such that members have the option to receive email alerts whenever new comments are posted

to discussion threads. This "push" feature helps keep people engaged who would otherwise forget to go "pull" for new activity. There is also a companion file repository section where members can post documents or files germane to those discussions and members can create directories and subdirectories to organize information in a way that makes the most sense for their respective teams. An Announcements section introduces new members joining the community and announces upcoming research events (e.g., symposiums and conferences). To help members identify each other and locate specific research interests or skills that may be helpful for specific initiatives, a section for staff information presents standard contact information. Lastly, the Communication Section provides various ways to send messages to ISS members. Together, the bundle of capabilities addressed each of the desired functionalities for the ISS community. Table 1 illustrates how the prototype supported the appropriate behavior profiles described in the conceptual background and the requirements identified by ISS members by mapping those aspects to specific features built into the Virtual Foyer interface.

Table 1: Linkage of Virtual Team Behavior Profile to Requirements to VF Capability Bundles

Virtual Team Behavior	ISS Requirements	VF Capability Bundles
Awareness	List and describe projects List current CFPs Make interests known Make skills known	Project postings in Discussion Board Researcher profiles in staff information area Automatic email alerts for new project postings Announcements feature
Social Exchange	Place to discuss ideas Place to post problems and get ideas for solutions Support desire to get involved	Discussion board Email feature
Shared Understanding ➢ Common language ➢ Background information		Discussion board Email feature Team pages feature Document sharing

Deployment

The interdisciplinary nature of the user group, especially the differences in technical skills in the group (which we would expect in any interdisciplinary team), drove several dimensions of the deployment phase. First, we developed a detailed user guide with extensive screen captures to show users visually how to navigate the entire system. After an internal review by the authors, this user guide was then tested on two members and modified based on their feedback. Before we distributed the user guide and officially opened the application, we "seeded" each of the areas with example postings. The idea was to present users with a working model of how they could use the Virtual Foyer. A few days after the user guide was mailed to the entire user group, one of the authors attended a user group meeting to reinforce that announcement, answer questions, and further explain how the system fit within their current operational paradigm. During this entire timeframe, both researchers actively monitored the Virtual Foyer to identify problems and answer questions before users became disenchanted or stopped using the system.

RESULTS

Usage patterns for the prototype Virtual Foyer were tracked by the statistics tracking module built into the system. In the first week of system use, over one-third of the user population (5 out of 14 people) had

either initiated an idea or entered replies to those ideas, and there were 18 new posts with nearly 100 "views" on the idea discussion area. After that initial surge of interest, use tapered and over the next few months, the totals stood at 29 posts with slightly over 150 "views." Four ISS members posted brief biographical sketches that identified their skills and interests, and the Announcements area was used to identify a new member of the community. Additionally, several members commented on the value of the automatic email feature that alerted them to new postings, specifically mentioning that this feature had increased their awareness of ISS activities. At least one group formed from Virtual Foyer members to work on a research initiative. However, that group contacted specific people they identified from the group and did not openly "advertise" their initiative through the system as originally envisioned in this effort.

Follow-up discussions with other ISS members have not yielded specific reasons why they have not engaged more actively with the system. A recurring comment has been "I'm not used to going to Blackboard for anything other than work related to my classes." One participant commented that she had looked at it, but that "there isn't enough information about enough different people yet to really be useful." Interestingly, this person had not provided biographical information yet or posted any comments into the discussion area. More in-depth follow-up interviews can be used to assess user reactions to the foyer, including their evaluations of the technology and built-in structure, and help identify system enhancements for the next version.

CONCLUSION

Results from the prototype implementation of the Virtual Foyer confirmed our expectation that interdisciplinary virtual teams need a flexible yet easy-to-use environment suitable for diverse technological skill levels. However, the low individual adoption rate reinforces the idea that finding a good balance point between simplicity and usefulness is an especially daunting challenge given the broad range of skill levels found on interdisciplinary teams. Another point that must be considered and explored is the true extent of interest that ISS members have in undertaking new research initiatives; it is conceivable that the level of use reflected in this system is an indicator that ISS members are simply not looking for that many additional research projects. Developing guidelines for making appropriate technology decisions in the face of an ever-burgeoning array of technology choices could represent a significant contribution to the success of interdisciplinary virtual teams. Continued research into the use of the Virtual Foyer could help identify appropriate mixes of technologies and social structures for members of virtual interdisciplinary teams to identify and engage in new initiatives.

User reports also substantiated the notion that having cues for the availability of new information is a valued facet of initiating activity within the group. Further study should examine how different media for those cues could be used and whether different media provoke different levels of response. For example, does receiving an alert via a Web-based RSS feed have more or less effect than an email message? Similarly, a review of discussion board comments provided indications of diversity which could lead to the incorporation of more perspectives into ISS initiatives, but more qualitative study is required to assess to what degree those comments were translated into engagement in specific initiatives.

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