

**Helping CSCW Applications Succeed:
The Role of Mediators in the Context of Use**

by

Kazuo Okamura
Masayo Fujimoto
Wanda J. Orlikowski
JoAnne Yates

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Kazuo Okamura

Information Systems Research Laboratory
Matsushita Electric Industrial Co., Ltd.
1006 Kadoma Osaka 571 Japan
Tel: 81-6-906-2443
E-mail: okamura@isl.mei.co.jp

Wanda J. Orlikowski

Massachusetts Institute of Technology
50 Memorial Drive (E53-329)
Cambridge, MA 02139 USA
Tel: 1-617-253-0443
E-mail: wanda@mit.edu

Masayo Fujimoto

The Sumitoto Research Institute, Inc.
27-2 Shinkawa 2-chome
Chuo-ku, Tokyo 104, Japan
Tel: 81-3-3297-4016
E-mail: LDD00672@niftyserve.or.jp

JoAnne Yates

Massachusetts Institute of Technology
50 Memorial Drive (E53-545)
Cambridge, MA 02139 USA
Tel: 1-617-253-7157
E-mail: jyates@mit.edu

ABSTRACT

This study found that the use of a computer conferencing system in an R&D lab was significantly shaped by a set of intervening actors--*mediators*--who actively guided and manipulated the technology and its use over time. These mediators adapted the technology to its initial context and shaped user interaction with it; over time, they continued to modify the technology and influence use patterns to respond to changing circumstances. We argue that well-managed mediation may be a useful mechanism for shaping technologies to evolving contexts of use, and that it extends our understanding of the powerful role that intervenors can play in helping CSCW applications succeed.

KEYWORDS: Computer conferencing system, contextualizing technology, intervention, technology use.

INTRODUCTION

Many analysts in the CSCW community have discussed why groupware has not always lived up to expectations. In his widely cited article, "Why CSCW Applications Fail" [8], as well as in more recent work [10], Grudin examines some of these problems, such as "the disparity between who does the work and who gets the benefit" [8: 86]. Others such as Bullen and Bennett [2] and Orlikowski [23] identify structural and cultural problems in integrating groupware into work practices, while Markus [18, 19] points to the lack of a critical mass of users as a central problem in groupware adoption. In this paper we report on a case where groupware was relatively successful, and we discuss the intervention that appears to have helped some of the problems mentioned above.

The technology implementation and use literature has identified several types of interventions that often help in the successful assimilation of new technologies. For example, technology champions have been found to facilitate the adoption of technological innovations [1, 12, 16, 21, 24]. Training, typically conceived of as part of the initial introduction of technology, has also received attention [e.g., 4]. More recently people have recognized the need for ongoing training for effective technology use [13, 25]. Studies of ongoing interventions in information technology use has also identified the influence of other organizational actors. Culnan [3] identified surrogate users, labeled chauffeurs, who provide information directly to individuals. In their review of literature on group decision support technologies, Kraemer and King [14] noted the importance of facilitators in using synchronous collaborative tools. Bullen and Bennett [2] observed that some organizations authorized support staff to provide ongoing guidance. In organizations without such sanctioned roles they found that expert users or local gurus emerged to fill the need. Similar to such expert users are translators [15], experienced users [22], lead users [27] and tailors [26].

We would like to extend this intervention literature by focusing on a particular type of intervention we call *technology-use mediation*. Our understanding of the central role played by *mediators*,¹ as we have termed them, emerged out of a study we conducted into the use of computer conferencing system by a large project group in one organization. While examining how this group had made use of its new communication technology, we realized that a small set of users had actively shaped other users' adoption and on-going use of the conferencing technology.

¹ Both Friedman [7] and Grudin [9] have discussed the role of third party players as mediators in systems development, but both position this role as an intervention in development. We use the term mediation to refer to a process occurring during use after development is complete.

Detailed analysis revealed that they had not only manipulated the conferencing technology over time, but that they had also guided and promoted users' understandings and uses of it.

This research study allowed us to look more analytically at the role of mediators, which we define as individuals who intervene deliberately and with organizational authorization in the ongoing use of CSCW technology within its context of use. More specifically, these mediators adapt a new collaborative technology to a context, modify the context as appropriate to accommodate use of the technology, and support ongoing changes to the technology and context over time. While our study only provides evidence from one organization, it raises the interesting possibility that mediators may be particularly important in increasing the effectiveness with which CSCW applications (and perhaps technologies in general) are adopted, implemented, and used over time.

Below, we describe the research study that led us to identify and explore the role, actions, and effect of mediators. We conclude with some implications of technology-use mediation for research and practice.

RESEARCH SETTING

The research study we conducted examined the introduction and use of an asynchronous computer conferencing system in the R&D lab of a large Japanese manufacturing firm. The system was being used to support communication among the members of a project group developing a new computer product, Acorn (a pseudonym). Because Acorn was expected to be an innovative product that would improve the company's competitive position, a new organizational and technical infrastructure was set up specifically to support the Acorn development effort. At the launching of the Acorn project, 127 members joined the project from other parts of the R&D lab, while another 50 new employees and external temporary engineers joined them during the 17 month life of Acorn. The project group was divided into six teams: an administration team, a hardware development team, and four software development teams. All Acorn project members had considerable experience with computers and many had experience with electronic mail (e-mail). However, most had never used computer conferencing before.

The computer conferencing system used in the Acorn project (known as the "news-system") was a version of the network news software widely used to run Usenet, modified to allow Japanese characters in the body (but not the subject line) of posted messages and restricted to internal use. This news-system was in operation and accessible by all Acorn members for the full 17 months of the project (from the end of September 1989 to February 1991), although it was only an official communication medium for the project from February 1990. The news-system was organized into topics, known as newsgroups, within which users could post and

read messages. The nature of the newsgroups varied considerably, from official newsgroups containing important announcements for the whole project group to informal newsgroups that were meant for recreational purposes. As described below, the number and type of newsgroups present in the new-system changed over time during the project; that is, some newsgroups were created, some shut down, while others changed in name, definition, and usage.

Some information on the news-system's early use in the R&D lab and on the emergence of the mediator role serves as useful background to our analysis. A year before the start of the Acorn project, a small group of young software engineers imported the news-system (with only three newsgroups--*general*, *miscellaneous*, and *recreational*) into the R&D lab for their own use. After being assigned to the Acorn project, they decided to set up a similar news-system specifically for the new project. Initially, the engineers' news-system activities continued to be unofficial and casual, and usage remained restricted in volume and user base in the early days of the Acorn project.

This informal group of engineers soon realized that a large project such as Acorn would require network administration to maintain linkages among the powerful workstations for communication and data transfer. Because Acorn's development was a major initiative involving many people, sharing information was especially important for establishing collaboration. The engineers explained the need for technical and administrative support for such a network to project managers and volunteered to play this role. In their justification, these engineers stressed the importance of having ongoing support for the project's technical and communication infrastructure. Once managers accepted this rationale, they authorized this group, named the Network Administration Group of Acorn (NAGA), to perform this function. NAGA members communicated their role and responsibilities to the rest of the project in team meetings, in a project newsletter, and in the following message, which they posted on the news-system:²

Subject: NAGA
Date: 30 Nov 89 11:10:28 GMT
Newsgroups: *misc*
....

Most of NAGA's activities are, by their nature, miscellaneous. ... All members share the view that no user-friendly computers can be created without being used by ourselves. Our goal is not only to achieve trouble-free use of the network, but also to increase the productivity of the project by improving communication among members. We hope that our project will take the lead in using the company-wide network.

² Electronic messages cited here were translated from Japanese.

At this point, NAGA was authorized and recognized as the committee responsible for administering the Acorn project's network and for establishing and promoting the news-system. These responsibilities were seen as a part of the members' regular job duties. NAGA was composed of nine members including the original group of software engineers interested in the news-system plus others added to ensure representation of each of the six Acorn teams. Decisions were made by consensus in face-to-face meetings of all NAGA members. Regular meetings were held on average twice a month and the minutes were distributed to NAGA members via e-mail. E-mail messages were also frequently exchanged among NAGA members to supplement their meeting discussions.

RESEARCH METHODS

Our study was designed to examine the policies and process through which the news-system was managed by NAGA over time. Two types of data were collected, interview and textual data. The interview data, used primarily to supplement the textual data, came from extensive and in-depth discussions in Japanese with one NAGA member over a number of weeks. Follow-up interviews to clarify specific points were conducted in English. The textual data consisted of computerized records containing all the e-mail messages exchanged among NAGA members, and all the newsgroup messages that were posted on the news-system by Acorn participants over the 17 months of the project.

Qualitative data analysis included careful examination of NAGA's e-mail messages and interview data. The e-mail messages were then coded for common topics and actions [6, 20]. This analysis yielded information related to the rules and policies enacted by NAGA during the project.

Over the period of the Acorn project, 438 e-mail messages were exchanged by the NAGA members. Of these, 223 dealt with administrative issues concerning the news-system. These messages were then categorized into common issues, thus yielding 97 specific topics (e.g., the addition of the *headlines* newsgroup) that the NAGA members had discussed during their meetings or in electronic dialogue. The topics were then categorized by type of NAGA action taken as a result of the discussion. This final categorization is reported below.

Over the 17 months of the Acorn project, 9302 messages were posted on the news-system. Two types of news-system messages were examined in our analysis: messages that were posted by NAGA members in the execution of their administrative activities, and messages that were posted by users around the time of NAGA's actions, as determined by the analysis of NAGA e-mail messages and newsgroup postings. We also mapped changes in news-system structure over time, using the date of the first

message in each newsgroup as the starting date for that newsgroup. Changes in the newsgroups comprising the news-system over time are shown in Figure 1 (see Appendix for newsgroup descriptions).

RESULTS

NAGA's messages were categorized by the type of action the members discussed:

- defining the role of the news-system;
- promoting understanding and appropriate usage of the news-system;
- modifying the definition and/or usage of a newsgroup;
- creating new newsgroups.

Figure 2 shows the distribution of these e-mail messages over time.

On the basis of these analyses and the interviews, we found that NAGA's activities could be divided into two distinct phases (see Figure 3). In Phase I, NAGA's actions were concentrated on defining the role of the news-system and promoting news-system usage, while in Phase II, NAGA's actions focused on changing the definition or usage of specific news-groups and the overall nature and structure of the news-system.

Phase I: Establishment of News-System

During the first few months of NAGA's activities, the group focused on establishing the technical infrastructure. In the last month of 1989 and the first of 1990, NAGA turned its attention to defining the role of the news-system and promoting its adoption by users. First, we will discuss their approach to policy-making, second, their differentiation of the news-system from other media already in use, and third, the steps they took to increase usage of the news-system.

Policy Making Process

NAGA started by developing a basic understanding of the role the news-system should play in Acorn, in particular considering whether it should be used for official communication. While NAGA began discussing this in meetings, they also solicited the participation of all project members. The following message triggered responses from project members who were already using the news-system:

Subject: New newsgroups
Date: 6 Dec 89 10:05:48 GMT
Newsgroups: misc

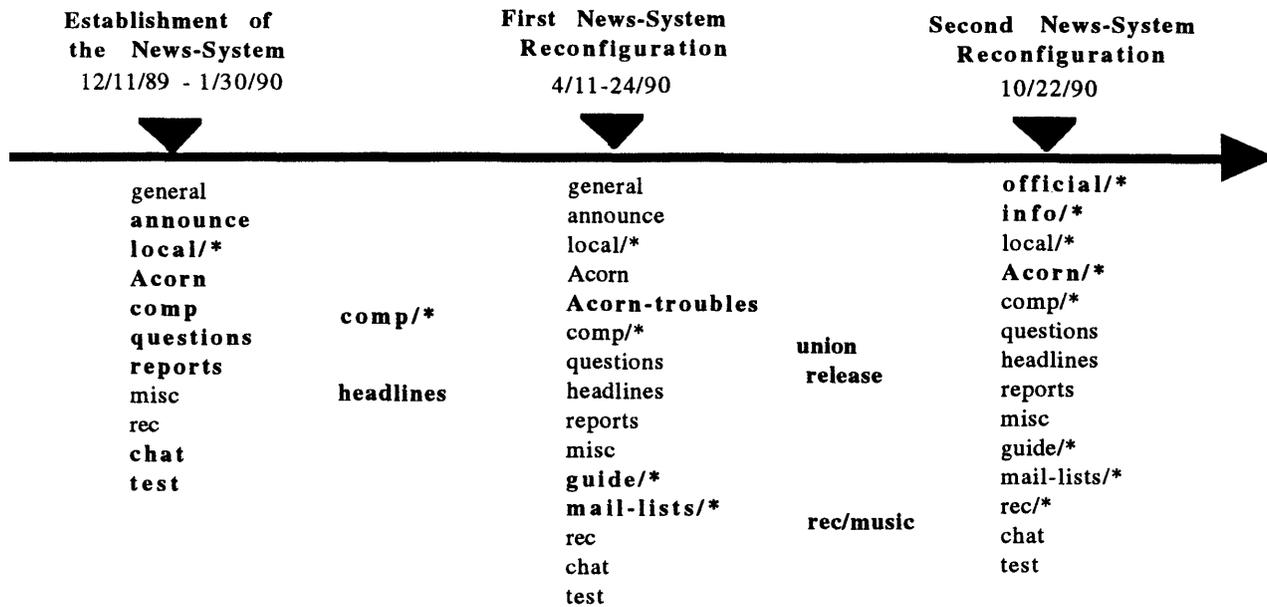
We need to discuss the following issues.

(1) The officiality of this news-system is unclear.

...

(2) The relationship of this news-system to bulletin boards within each team, and any e-mail mailing lists is unclear. As long as we use only these closed media, we cannot share useful information among all project members.

=> Should we not gain the advantage of many members working together?



Note: Bold font represents the point at which a newsgroup was first created. Newsgroups followed by /* indicate the presence of several newsgroups nested hierarchically within the named newsgroup.

Figure 1: Changes in the Acorn News-System

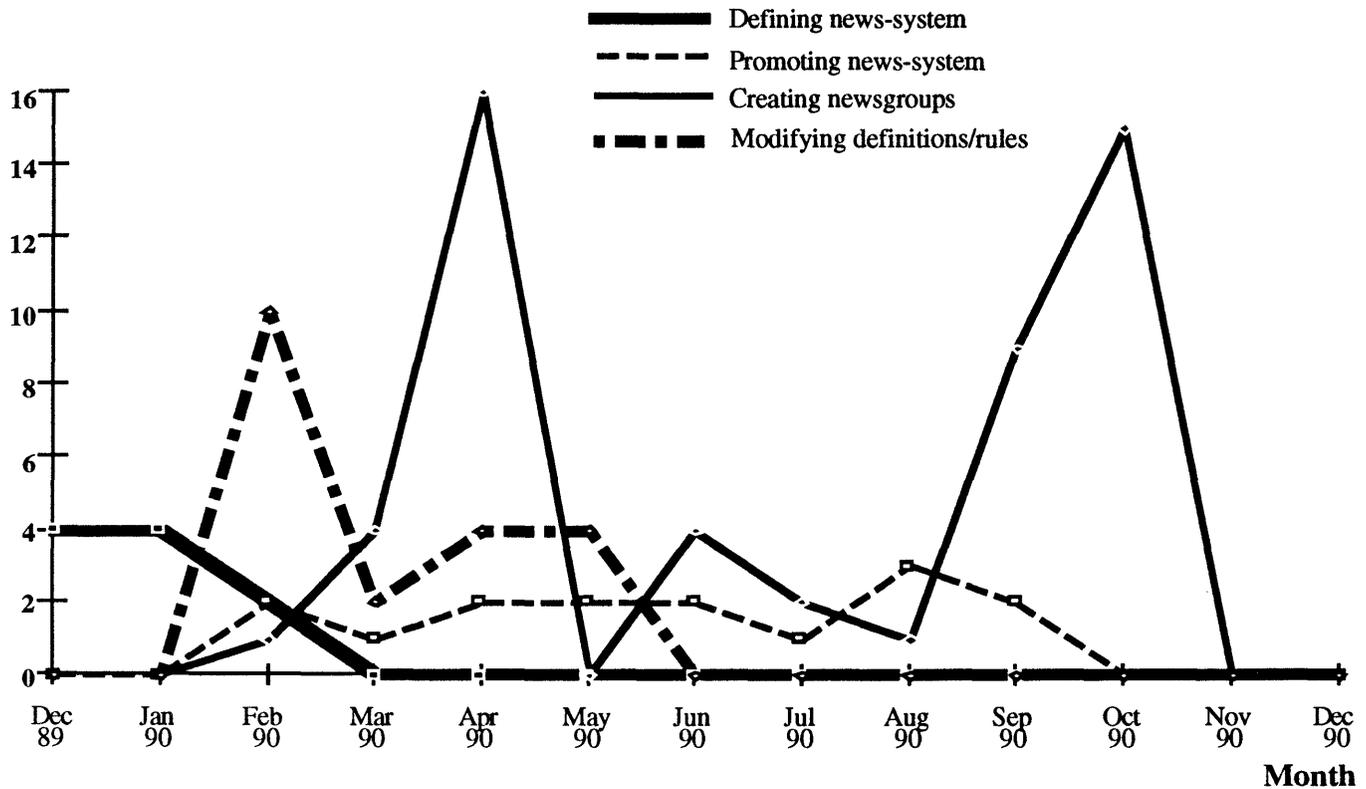


Figure 2: Distribution of NAGA E-mail Messages over time

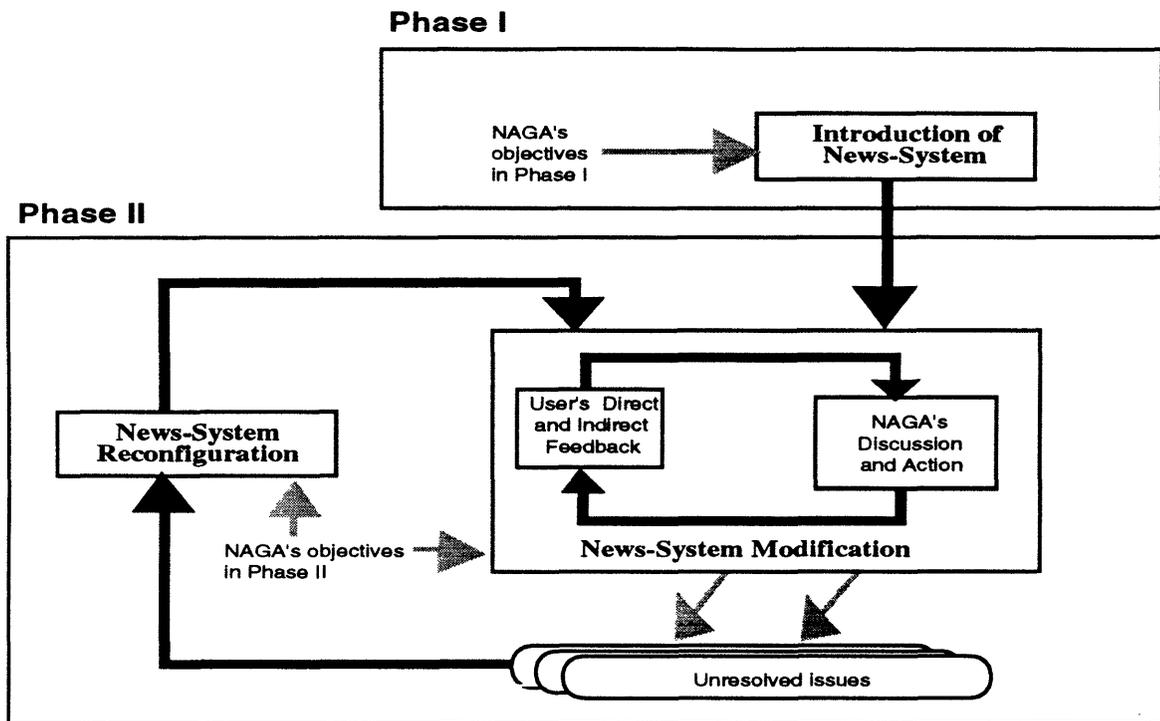


Figure 3: Changes in the news-system as a result of NAGA's actions

Most users who responded endorsed the introduction of the news-system as the project group's official communication medium. As one project member pointed out, the fact that they were developing new technology motivated them to try the new communication technology. Without such motivation, project members might not have been willing to incur the costs of learning a new technology. Because many project members were not yet using the news-system and thus did not reply to this message, NAGA members also talked individually with many such team members. In addition, NAGA members consulted with project managers because their consent was critical if the committee was to implement its administrative objectives.

This policy making process demonstrates NAGA's administrative objectives and their implications. The messages sent by NAGA members indicate their interest in making the news-system an official communication medium. For example, the question: "Should we not gain the advantage of many members working together?" suggests that they believed using the news-system would benefit the group's work. At the same time, NAGA members solicited other project members' ideas instead of directing them to use the news-system as an official communication medium. NAGA's approach enabled it to build general support among all project members to accept the news-system as an official communication medium.

Differentiation from Other Media

Having achieved some consensus that the news-system should serve as an official communication medium, NAGA turned its attention to realizing this goal. To achieve this, NAGA felt it must position the new medium in relation to the other communication media commonly used in the firm. It started to investigate and discuss how daily lunch-time meetings,³ routing-slips, bulletin boards, and e-mail were currently being used and understood in the project group. NAGA then redefined the uses of these various media in the context of the news-system. Their decision was documented in the following meeting minutes:

 To: NAGA
 Subject: Meeting report from December 26, 1989

...
 Communication media within the project

<principle>

Currently, daily lunch-time meetings, routing-slips, bulletin boards, e-mail, and the news-system are used as communication media. Our purpose is to encourage the use of the news-system.

<daily lunch-time meetings>

The purpose of daily lunch-time meeting should be restricted to confirmation of information that has been

³ By company policy, each division or group had a daily lunch-time meeting, in which formal and official information was usually announced.

announced in the news-system beforehand. This meeting should not be an official announcement tool.

<routing-slips>

The routing-slip will be terminated. Printed information should be posted on bulletin boards and we should direct project members to use the news-system as much as possible.

<bulletin boards>

Bulletin boards can be used only for printed information. However, all information should be provided through the news-system and at least summaries have to be posted on the news-system.

<e-mail>

Precise e-mail use guidelines should be set. E-mail must be used only for urgent or confidential information. The definition of 'urgent' information: information that should be shared within a day.

Clearly, NAGA's objective was to encourage news-system use by allocating most of the information exchanged within the Acorn project to the news-system. Based on this positioning of the news-system's role, NAGA added several new newsgroups to the original three, including *announce* for official project announcements, *Acorn* for general discussions of the project, and *computers* for general computer-related issues. NAGA also created definitions and usage rules for each newsgroup. A definition included the appropriate message content and purpose of a newsgroup, while usage rules were norms about use such as the requirement that users read two mandatory newsgroups (*general* and *announce*) at least once a day.

Promoting Use of the News-System

Having established the news-system and having articulated its purpose and role in the project to their own satisfaction, NAGA members championed its adoption. Specifically, they took a number of actions to encourage members to use it. First, NAGA persuaded the Acorn project managers to require project members to use the news-system (in particular, to read messages in the two mandatory newsgroups) daily. This support from the managers was very influential in making the news-system an official communication medium. Second, NAGA introduced all members of the project group to the definition and usage of the news-system in the following message, posted on the day that project managers announced that the news-system was now an official and mandatory medium for the project:

Newsgroups: *announce*

Subject: Guideline for the usage of mail & news

Date: 30 Jan 90 11:03:28 GMT

...

(1) Use e-mail and the news-system effectively!

If you want to send information to some specific person, e-mail may be useful. However, when you send it to a group of

people or to all members in the division, please use the news-system as much as possible.

If you use e-mail all the time, we will receive a huge number of messages and have to read all of them. Remember the difference between a traditional bulletin board posting and a letter. Think again when you send an e-mail message to any mailing-list (like all@xxx) You may be able to provide useful information to other project members by using the news-system.

The news-system will function as an official tool starting in February 1990.

(2) Obligation to access both e-mail and the news-system

NAGA has established a facility allowing all members to use both Mail and News

We will support it to make sure that everyone is comfortable using these systems.

All members must access Mail/News:

e-mail: Twice a day both in the morning and afternoon

News: At least once in the morning to specific newsgroups--the general and announce newsgroups

*If you want us to send messages on the *general* and *announce* newsgroups by e-mail, NAGA will provide a service to send messages by e-mail automatically.

*You also can post a message by using the e-mail function.

Third, as evident in the above message, NAGA made it easier for reluctant users (mostly managers) to use the news-system by creating a technical facility that allowed them to receive from and send messages to the mandatory news-groups via e-mail. They also created a *test* newsgroup, which allowed individuals to experiment with the technical features of posting messages in the news-system.

Fourth, NAGA completed the initial configuration of the news-system by creating the *local* newsgroups, one for each of the six project teams, to convey information previously exchanged via e-mail mailing lists. This set of newsgroups was intended in part to provide an easy way for beginners to start using the system, allowing them to address their smaller team rather than the whole project. Indeed, this tactic seems to have worked, since almost half of all messages on the news-system in the early weeks after the system became official were on the local newsgroups. Later, that proportion dropped to about one third as more discussion shifted to the non-local newsgroups. At the same time that local newsgroups gave the impression of a more intimate audience, messages posted to local newsgroups could, in fact, be read by others. NAGA did not restrict access to the local newsgroups, and even encouraged Acorn members to read other local newsgroups and contribute where relevant because they believed that sharing information across as well as within local teams would ultimately benefit the project as a whole. This was a deliberate attempt by NAGA to increase communication

across the six project teams, and the strategy appears to have been effective, as 33% of the messages posted in local newsgroups were contributed by members of other teams. Cross-fertilization between the groups occurred on some occasions via this mechanism, as when someone posted a message on another team's *local* newsgroup starting with, "I am an outsider, but I would like to explain my idea about [a certain topic]."

Finally, NAGA improved the news-system software to allow Japanese subject lines as well as Japanese text in messages. This improvement made the news-system a more convenient and more readily accessible tool for users. These five types of action had the effect of making it easier and more relevant for project members to post messages. The result was a dramatic increase in the number of messages posted on the news-system, from approximately 20 messages per week to approximately 200 messages per week (see Figure 4). This level of use was sustained (excluding holiday periods) until the announcement of Acorn's termination in late January, 1991. At that point, usage fell off dramatically for the last month of the project.

Phase II: Ongoing Support of News-System

Once the news-system was established, NAGA continued to play a central role in its on-going evolution in response to participant feedback and its own evolving objectives. As Figure 3 shows, this evolution involved two types of change: modifications and reconfigurations. First, NAGA members responded to specific problems by modifying definition and usage rules, and occasionally by adding a new news-group. In some cases, the problems were not resolved by such modifications, or NAGA members saw their actions as merely temporary measures. In this case, they accumulated the unresolved issues and addressed them through periodic reconfigurations in which they created sets of new newsgroups or restructured the schema of the news-system. Figure 1 depicts the change in news-system configuration over time. In both types of intervention, user feedback was a critical trigger.

User Feedback

Four types of feedback from users were observable. First, users provided indirect feedback when they violated usage rules and posted messages improperly. For example, some people violated a usage rule by accessing the *rec* newsgroup during office hours, an activity prohibited by NAGA at the request of the project managers. These messages were observed by NAGA members largely because as users they also participated in the newsgroups. Second, users included their questions or confusions about the news-system in their messages. Third, users sent more direct feedback in the form of questions and suggestions to NAGA members, either through face to face interaction or e-mail. NAGA members did not hesitate to talk with users directly and they gathered users' feedback through general conversation. Fourth, NAGA gathered information from users about the

news-system by posting soliciting messages on the news-system.

Through these various modes of feedback, project members interacted with NAGA and hence influenced, deliberately and inadvertently, the mediation of their news-system. In response, NAGA changed the news-system via minor modifications and major reconfigurations.

News-System Modifications

Between the periodic reconfigurations of the technology, NAGA responded to users' questions and problems by enacting minor adjustments and enhancements. These modifications may be categorized into three groups. First, NAGA established definitions and promoted proper usage of news-groups, especially after creating new ones. NAGA members often advertised new newsgroups in the project newsletter and daily lunch-time meetings, as well as on the news-system. They also encouraged appropriate usage through education. For example, they encouraged users to only embed relevant portions of previous messages rather than entire messages. All such educational efforts were not equally effective, however. For example, NAGA members were never entirely successful in restricting use of the *rec* newsgroup to non-work hours.

Second, NAGA modified the definitions and usage rules of newsgroups. For example, the early definitions of the two mandatory newsgroups, *general* and *announce*, were vague and many users were consequently confused about which newsgroup was appropriate for their messages. These categories were even used as default categories by some users. Because these newsgroups were required reading for everyone, NAGA felt that the number of messages in them should be limited, and that only those messages critical to all project members should be included. NAGA modified the definition and usage rules of these two newsgroups several times trying to achieve the desired balance. (This problem was ultimately solved as part of the second news-system reconfiguration, discussed below, when they replaced these two newsgroups with a new one, *official*, which had a moderator who screened all messages before posting them.) NAGA members discussed the potential for improper use and confusion when discussing the creation of a new newsgroup. However, sometimes the necessity for new usage rules only became apparent after a certain period of use.

Third, in response to user requests, NAGA occasionally created new newsgroups at times other than major reconfigurations. For example, a project member who was responsible for various magazine subscriptions and book orders posted the following message querying the appropriateness of a message announcing such an acquisition to the *announce* news group.

Newsgroups: *announce*
Subject: Subscription to magazine xxx
Date: 13 Feb 90 02:40:16 GMT
Distribution: Acorn

Subscriptions of two magazines were started last month. They are in xxx bookcase. Please read them at your convenience.

I would like to send reference messages about new books each month because building B is separated from the main building, so this will be useful for people who are working in building B. May I post these messages to this newsgroup? Or is there any other more proper newsgroup?

Soon after this posting, NAGA established a newsgroup called *headlines* for the specific purpose of posting announcements of new subscriptions, new books, or articles of interest to the project. For the rest of the project, this same person used this newsgroup a few times a month to point members to new materials.

being changed and why new newsgroups were being introduced.

The first news-system reconfiguration, in April 1990, was motivated primarily by NAGA's responses to users' requests, including requests to extend the functionality of the news-system. For example, the new *guide* newsgroups functioned as databases for archival copies of messages rather than as interactive news-groups from which older messages were purged every three months. This new type of newsgroup allowed members to reuse or refer to useful information such as maps, addresses lists, and administrative procedures.

The second news-system reconfiguration took place in October 1990. Because some newsgroups were not being used effectively and the number of newsgroups had increased, NAGA members felt that reducing access time and promoting proper use had become an urgent objective. Hence, they re-organized the entire structure of the news-system, changing the allocation of information among the newsgroups as well as creating new newsgroups. Some

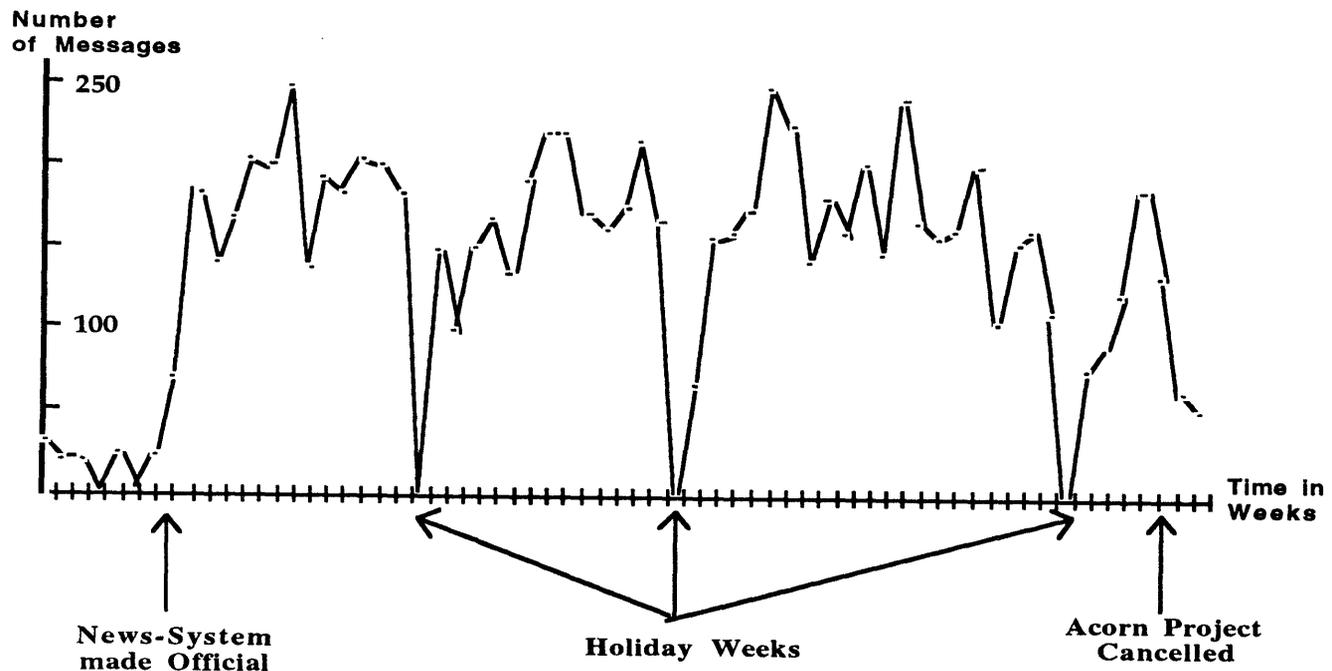


Figure 4: Use of News-System over time

News-System Reconfigurations

As the news-system became a widely recognized communication tool, users requested the creation of new newsgroups and NAGA members also observed new uses of the news-system. This led them to reconfigure the news-system twice during the project, resolving previously unresolved issues and shaping the system according to their evolving objectives. At each reconfiguration, NAGA members announced how the news-system structure was

newsgroups were terminated or replaced by new newsgroups and all newsgroups were better classified and their usage more clearly defined. NAGA announced the reconfiguration schedule and details in a long message posted to the *announce* newsgroup on October 17 of 1990, the beginning and end of which is reproduced below:

Newsgroups: *announce*
Subject: A reconfiguration of the news-system
Date: 17 Oct 90 00:49:42 GMT

Information on a reconfiguration of the news-system

- *****
- The news-system will be changed on October 22.
 - This message explains new newsgroups and
 - terminated newsgroups.
- *****

We introduced the news-system one year ago and now it has become an indispensable medium for our division. As the number of messages has increased, several problems have come up. For example, some newsgroups are used improperly, some newsgroups are not used at all. Therefore, NAGA has changed the configuration of the newsgroup structure. This message provides information on the new news-system.

NAGA thinks that the news-system schema should be changed depending on the situation. We would like to manage flexibly. This modification is one of those actions.
NAGA

As this message indicates, NAGA clearly saw occasional reconfigurations as part of its on-going role in shaping the use of the news-system to the changing context of the project group. Its role ended only when the project was canceled several months later (for reasons unrelated to internal project communication).

CONCLUSION

NAGA's actions in modifying and reconfiguring the news-system responded to users' feedback, and changing organizational circumstances. At the same time, these actions were not simply reactive, but reflected NAGA's objectives at different points in the news-system's evolution. Moreover, while NAGA's overall goal of creating an effective communication system for the project group did not change, their specific objectives changed from a focus on initial establishment in Phase I to a focus on supporting ongoing effective use in Phase II.

This study only examined a single site; hence, further studies are needed to assess the circumstances under which different kinds of interventions, including mediation as we defined it, are more effective than others. Our analysis has, however, facilitated the development of a detailed understanding of how, on the one hand, policies and actions of mediators influenced users' use of a computer conferencing system, and how, on the other hand, users' feedback, experiences, and patterns of use influenced the policies enacted and actions taken by mediators. We suggest that because such mediators directly influence users' interactions with their technology, they can have a profound effect on how usable, appropriate, and relevant the technology is (and remains) in particular contexts of use. These findings should benefit both research and practice.

For researchers, the study has highlighted the role of a set of organizational actors that have received relatively little emphasis in the CSCW literature. While researchers in various areas have recognized the role of technology champions [1, 21, 16, 24] and trainers [2, 4, 23], these characterizations have focused on specific and generally upfront tasks of promoting adoption of technological innovations and training on the use of particular applications. Others have examined the role of expert users [2, 15, 22, 26, 27] in shaping use in particular contexts. This role, however, is rarely organizationally recognized and rewarded, leading to the kind of disparity Grudin [8] identified between who does the work and who gets the benefit.

Our conceptualization of technology-use mediation goes beyond these prior understandings. We suggest that all these roles may usefully be understood as instances of intervention, and hence that in addition to serving specific functions, they also can and do have a significant influence on how technologies relate to certain contexts of use. This study allows us to propose that mediation -- as an ongoing and organizationally sanctioned intervention -- may be particularly effective at overcoming some of the problems in CSCW use identified by other researchers. For example, NAGA avoided the effort-benefit disparity just noted by securing recognition and resources for their intervention activities. In addition, NAGA addressed the critical mass issue [18, 19] by obtaining a project-wide mandate for use of the technology. While this particular solution worked in this case, it may not work in all organizational contexts. Nevertheless, organizationally-sanctioned mediators are in a better position to recognize and address the critical mass problem. NAGA was also able to deal with structural and cultural barriers [2, 23] as they arose because they were observing and reflecting on news-system use. For example, recognizing the importance of dialogue in the work practices of local project teams, they created *local* newsgroups to support these discussions. They also used these *local* newsgroups as an opportunity to promote system usage in a more comfortable forum.

For designers, our study confirms the view that design extends beyond the designers' workshop and into the setting of organizational use. Specifically, our findings suggest that in addition to providing users with tailorable tools [e.g., 5, 11, 17] designers could also provide tools for mediators to use in their activities of contextualizing technologies. The tools supplied to mediators might be similar to those given to users but could also allow for more sophisticated manipulation and reconfiguration which the technically-skilled mediators are more likely to be willing, able, and authorized to perform.

For practitioners, our findings suggest that a CSCW application was introduced and used relatively effectively because a group of mediators managed not only the technical issues, but also issues of context and use, with

carefully planned objectives and constructive reactions to users' feedback. This suggests that intervenors may be more effective when they have organizational authorization and play an ongoing role in facilitating technology use. In addition, based on our observations of NAGA, we can propose more specifically that mediators might be more effective in their interventions when they are:

- users as well as mediators;
- sensitive to user feedback;
- technically adept.

The nature and efficacy of mediation is likely to depend considerably on the type of individuals involved. Where mediators are themselves users and thus have intimate knowledge of the context of use as well as credibility with the users, their actions will be more locally appropriate and more likely to be accepted by the users. Whether or not they are users, they must be sensitive to the needs--technical and organizational--of the (other) users. Further, being technically skilled clearly allows mediators to make more extensive changes to the system being used. The extent and effect of mediation also depends on the authority granted and resources made available to mediators. Intervention occurs, with or without careful deliberation and management. We would suggest that where the role and influence of intervenors is recognized, sanctioned, and supported, such mediation can advance particular kinds of innovative and locally customized uses of technology, and allow the evolution of its use over time.

Further studies are, of course, needed to assess which of these characteristics are most important, and under which circumstances. But this study at least provides some guidance for practitioners thinking about implementing new CSCW technologies. It may also improve their appreciation and support of a set of actors often relatively unappreciated by managers, though perhaps less so by users who benefit from their activities.

Our description and analysis of NAGA's actions also suggest some actions that mediators may employ to facilitate the ongoing contextualizing of technologies in use.

- regular solicitation of user feedback to stay in touch with user concerns and use issues;
- ongoing monitoring of usage patterns to detect errors, misunderstandings, and areas of potential improvement;
- routine minor modifications of technology and usage guidelines to maintain and promote current use;
- periodic reassessments and changes to the technology and its norms of use to reflect changed organizational and technological circumstances.

These actions should have some heuristic value as a starting point for practitioners in thinking about and experimenting with mediation.

As a final note, we believe that our research raises the interesting possibility that the influence and action of mediators may play a critical role in helping CSCW applications succeed in organizational contexts.

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REFERENCES

1. Beath, C.M. Supporting the Information Technology Champion. *MIS Quarterly*, 15, 3 (September 1991), 355-371.
2. Bullen, Christine V. and Bennett, John L. Groupware in Practice: An Interpretation of Work Experience. In *Proceedings of the Conference on Computer Supported Cooperative Work* (October, Los Angeles, CA), ACM/SIGCHI, NY, 1990, pp. 291-302.
3. Culnan, Mary J. Chauffeured Versus End-User Access to Commercial Databases: The Effects of Tasks and Individual Differences, *MIS Quarterly*, 7, 1 (March 1983), 56-67.
4. Davis, G.B. and Olson, M.H. *Management Information Systems* (2nd Ed.), McGraw Hill, New York, NY, 1974.
5. DeJean, D. and DeJean, S.B. *Lotus Notes at Work*. Lotus Books, New York, NY, 1991.
6. Eisenhardt, K.M. Building Theories from Case Study Research, *Academy of Management Review*, 14, 4 (1989), 532-550.
7. Friedman, A.L. *Computer Systems Development: History, Organization, and Development*. John Wiley, Chichester, UK, 1989.
8. Grudin, J. Why CSCW Applications Fail: Problems in the Design and Evaluation of Organizational Interfaces. In *Proceedings of the Conference on Computer Supported Cooperative Work*, (September, Portland, OR), ACM/SIGCHI & SIGOIS, NY, 1988, pp. 85-93.
9. Grudin, J. Interactive Systems: Bridging the Gaps between Developers and Users. *IEEE Computer*, (April 1991), 59-69.
10. Grudin, J. Groupware and Social Dynamics: Eight Challenges for Developers. *Communications of the ACM*, 37, 1 (January 1994), 93-105.
11. Henderson, A. and Kyng, M. There's no place like home: Continuing Design in Use. In Greenbaum, J. and Kyng, M. (eds.), *Design at Work*, (Erlbaum, Hillsdale, NJ, 1991), 219-240.

12. Howell, J.M. and Higgins, C.A. Champions of Technological Innovation, *Administrative Science Quarterly*, 35, 2 (1990), 317-341.
13. Johnson, B.M. and Rice, R.E. *Managing Organizational Innovation: The Evolution from Word Processing to Office Information Systems*. Columbia University Press, New York, NY, 1987.
14. Kraemer, K.L. and King, J.L. Computer-based Systems for Cooperative Work and Group Decision Making. *ACM Computing Surveys*, 20, 2 (June 1988), 115-146.
15. Mackay, W.E. Users and Customizable Software: A Co-adaptive Phenomenon, Unpublished Ph.D. Thesis, (MIT, Cambridge, MA, 1990).
16. Maidique, M.A. Entrepreneurs, Champions, and Technological Innovation. *Sloan Management Review*, 21, 2 (Winter 1980), 59-76.
17. Malone, T.W., Lai, K.Y. and Fry, C. Experiments with OVAL: A Radically Tailorable Tool for Cooperative Work, *Proceedings of the Conference on Computer Supported Cooperative Work* (November, Toronto, Canada), ACM/SIGCHI & SIGOIS, NY, 1992, pp. 289-297.
18. Markus, M.L. Towards a "Critical Mass" Theory of Interactive Media: Universal Access, Interdependence and Diffusion. *Communication Research*, 14 (1987), 491-511.
19. Markus, M.L. and Connolly, T. Why CSCW Applications Fail: Problems in the Adoption of Interdependent Work Tools. In *Proceedings of the Conference on Computer Supported Cooperative Work* (October, Los Angeles, CA), ACM/SIGCHI & SIGOIS, NY, 1990, pp. 371-380.
20. Miles, M.B. and Huberman, A.M. *Qualitative Data Analysis: A Sourcebook of New Methods*. Sage Publications, Newbury Park, CA, 1984.
21. Modesto, M.A. Entrepreneurs, Champions, and Technological Innovation. *Sloan Management Review*. 21, 2 (Winter, 1980), 59-76.
22. Nardi, B.A. and Miller, J.R. An Ethnographic Study of Distributed Problem Solving in Spreadsheet Development. In *Proceedings of the Conference on Computer Supported Cooperative Work* (October, Los Angeles, CA), ACM/SIGCHI & SIGOIS, NY, 1990, pp. 197-208.
23. Orlikowski, W.J. Learning from Notes: Organizational Issues in Groupware Implementation. *Proceedings of the Conference on Computer Supported Cooperative Work* (November, Toronto, Canada), ACM/SIGCHI & SIGOIS, NY, 1992, pp. 362-369.
24. Schön, D.A. Champions for Radical New Inventions, *Harvard Business Review*, 41, 2 (March-April 1963), 77-86.
25. Strassman, Paul A. *Information Payoff: The Transformation of Work in the Electronic Age*. The Free Press, New York, NY, 1985.
26. Trigg, R.H. and Bødker, S. From Implementation to Design: Tailoring and the Emergence of Systematization in CSCW. In *Proceedings of the Conference on Computer Supported Cooperative Work* (October, Chapel Hill, NC), ACM/SIGCHI & SIGOIS, NY, 1994.
27. Von Hippel, E. *The Sources of Innovation*. Oxford University Press, New York, NY, 1988.

APPENDIX

Descriptions of Acorn Newsgroups

Newsgroup	Description
<i>Acorn</i>	Discussions related to the computer product under development
<i>announce</i>	Official announcements to entire project
<i>chat</i>	Informal discussions
<i>comp</i>	Discussions about computer-related topics (e.g., computer architecture)
<i>general</i>	Important announcements to entire project
<i>guide</i>	Archives of useful administrative information (e.g., procedures, maps)
<i>headlines</i>	Announcements of newly acquired journals, books, and articles
<i>info</i>	General company-related information bulletins
<i>local</i>	Discussions of topics specific to each of the 6 product development teams
<i>mail-lists</i>	Technical newsfeed from external party
<i>misc</i>	Discussions about miscellaneous topics (e.g., the air conditioning system)
<i>official</i>	Official announcements to entire project (replaces <i>announce</i> and <i>general</i>)
<i>questions</i>	Questions posed to entire project
<i>rec</i>	Discussions of recreational activities during non-work hours (e.g., hobbies)
<i>release</i>	Product release information
<i>reports</i>	Trip reports (e.g., conferences, meetings)
<i>test</i>	For testing the news-system software
<i>union</i>	Announcements about company union activities