In W. Prinz, T. Rodden, J. Hughes, and K. Schmidt (eds.), Proceedings of ECSCW'97, Sept. 7-11, Lancaster, England, Kluwer Academic Publishers, Dordrecht, 1997, pp. 253-268.

Supporting Groupware Conventions through Contextual Awareness

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Abstract: Conventions are an important part of articulation work. They are a means to merge the various perspectives and workstyles that are involved in handling shared objects in CSCW. We report on convention use with a groupware system used in a government ministry. Our findings suggest that defining, establishing, and following conventions is aided by the visibility of other people's activities using the system. We describe a prototype that supports users in maintaining conventions by providing awareness facilities and an overview for shared objects.

Introduction

A groupware system, such as a shared workspace, is a social environment. People's actions do not occur in isolation; changes to shared documents and to file structures are not independent, and actions can, in fact, have adverse consequences for others. If someone removes a document from a shared workspace, renames a document, or rearranges files into new subdirectories, then others may have problems locating the documents.

Any cooperative activity involves reconciling individual work styles to achieve common procedures and representations (Gerson and Star, 1986; Schmidt and Bannon, 1992). Though shared workspace members may be spatially distributed, their actions do not occur in a vacuum, and even the simplest procedure often involves negotiations among group members. Conventions are a means to merge the various perspectives and workstyles that are involved in handling shared

objects. We consider conventions for a groupware system to be rules or arrangements established in the group, common and accessible to its members, that users need in order to cooperate effectively with the system. While conventions may include social protocols, i.e. common rules for behavioral interaction such as speaking turns, we concentrate on those that are based on explicit agreements on common procedures for using system functionality.

We examined the role of conventions with real users in the POLITeam project. POLITeam is a groupware system designed to supplement paper work processes with electronic work processes in a government ministry. The larger aim is to support telecooperation between Bonn and Berlin as the German government relocates. The main tools that POLITeam offers are a shared workspace and electronic circulation folders (Prinz and Kolvenbach, 1996). An already existing groupware system (LinkWorks[1]) was chosen and adapted to specific user and situation requirements. The system has been installed since January, 1995. For further information, see Klöckner et al., (1995), and Mambrey et al., (1996).

This study began as a result of a workshop discussion with the design team and users in June, 1996, during which the users reported that a major requirement for them was establishing conventions for the system use. Some examples of conventions that the users cited at the workshop as necessary were: *naming conventions for documents* (e.g. by creator vs. content and semantics); *storing old and current documents*; *shared task processes* (document changes, access rights, storage, editing, ownership, producing new documents, and document type); *and substitution rules* (when a workspace member is absent). Our users considered obligation to be a key word for conventions to make cooperation possible.

Conventions with Shared Objects

The standard approach taken in CSCW-systems is best characterized by the notion of a shared object[2]. A shared object gives a group of users access to common information together with facilities to manipulate the data. However, in an organizational work arrangement the same piece of data is subject to different specialized activities, opinions, perspectives and interests (see e. g. Star and Griesemer, 1989). According to Schmidt and Bannon (1992), cooperative work occurs when people are mutually dependent in their work; the role of systems support thus becomes far more complex than simply distributing the control or access points of the common data. Cooperative work involves setting procedures for coordinating a number of subtasks when using shared objects. This

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[1] LinkWorks™ is a groupware product by Digital.

[2] We use the term “shared object” to distinguish it from the term “common artifact” (e.g. Robinson, 1993) to denote it as an object void of properties that are attributed to common artifacts, e.g. overview, peripheral awareness, etc.

articulation work forms the necessary overhead of coordination and cannot be prescribed formally in terms of task procedures; rather, a key characteristic of it is the continual flexibility in response to unanticipated changes and developments (Gerson and Star, 1986). One aspect of articulation work is establishing conventions so that the group can reach a shared understanding about the common usage of a shared object. The agreements must be consistent among users, yet robust and flexible enough to adapt and evolve, in response to local contingencies.

Individuals need to be aware of the activities of others in using a shared object to help them accommodate their own work styles to others in the group. Rogers (1993) reports on the use of conventions for managing files: group members checked out files by using a whiteboard in a common office as a mediating mechanism; each persons' activities were visible to the group. The convention enabled the group members to adjust their own work practices as they became aware of others' actions. Whereas Rogers' example illustrates explicit dissemination of awareness information, awareness may also result from implicit means, e.g. monitoring others' use of common objects (Heath and Luff, 1992; Hughes et al., 1992).

In addition to peripheral awareness, Robinson (1993) proposes other functional design considerations that address the multidimensional nature of shared object work: 1) the usage, function, and purpose of a shared object have to be clear and predictable, 2) a shared object must provide an overview; its presentation should convey its current state of use clearly, and 3) shared objects should include a dimension to account for both explicit and implicit communication.

Awareness information can complement and enhance these functional dimensions. First, it can enhance an object's predictability; it can help users to extrapolate an object's function in various circumstances by making its usage visible. This is sufficient according to Fischer (1991); a model of a system need not be technically accurate, but instead should be functional and fit for a purpose. Second, providing awareness information, e.g. the chronological usage of an object, can give an overview. With an overview, conventions can be formed around local contingencies: e.g. if a document is six months old, then file it in the archive. Third, awareness can complement the double level language facility of a shared object, by making salient "intuitive" access points for communication. For example, a system can provide facilities for clicking on a workspace member's icon to initiate a videoconference. If one sees that another is removing a document from a shared folder, then this can be a catalyst for informing the other of a broken convention. Thus, both awareness and multidimensionality in the design of shared objects can support conventions for an objects' use.

Awareness can be further qualified in terms of:

- *Reliability*: The dissemination of awareness information of the shared object needs to be clear and reliable. In Rogers' example, the convention functioned because the whiteboard made it clear to everybody in the group that all were aware of new files being checked out.

- *Cost and benefits:* Conventions for shared objects are like any aspect of cooperative system usage: subject to costs and benefits. Group calendars often fail if those putting in the extra effort are not those that benefit (Grudin, 1988). In Rogers' example, when peripheral awareness created an imbalance in costs and benefits, then the convention was broken. If the shared object actively collects and distributes awareness information, then following the conventions has a twofold advantage: sending information has no additional overhead and receiving it is not under the sender's control (Dourish and Bellotti, 1992).
- *Adaptation:* Providing awareness of others' work may potentially overload the user with information. In Roger's example, users were only peripherally aware of someone writing on the whiteboard, and were not disturbed in performing their task. Only by writing on the whiteboard did they became aware of exactly which files were checked out, an essential requirement for the convention to work, i.e. preventing file clashes. Thus, shared objects should smoothly adapt to changing work situations by providing differently focused awareness information. Since any notion of a work situation necessarily is subject to personal work practice, the system should allow users to individually tailor when, how, and where the awareness information is provided.

Research Setting and Methods

The focus of our study was done with users at the Federal Ministry of Family Affairs, Senior Citizens, Women, and Youth, located in Bonn, which currently has 12 primary POLITeam users: 1 unit leader, 6 ministry employees (responsible for specific content areas of the ministry), 3 typists in their own service unit, and additionally in Berlin, 2 users. The Bonn employees are distributed on two floors of the ministry and collaborate using the shared workspace and email. They perform services such as answering citizens' requests, doing tasks for the Minister, and collaborative speechwriting.

Our results are from a collection of material: workshops, site visits, design-team-user discussions, and user interviews. Initial semi-structured interviews were conducted before the system was introduced in order to learn about the potential users' work practice. Transcripts were also used from four workshops, in which the design team met with users: shortly after the first system version was finished, six months after the system introduction, in February of 1996 to present the new system version, and in June of 1996 to discuss specific new system features. A long list of user requirements for conventions emerged during this workshop.

This last workshop was followed after five months by a series of semi-structured interviews with the users, which lasted from 1 to 3 hours each. In these interviews, users were asked about: training and support, individual and collective work with the system, cooperation and use of information, the search facility, awareness of others, the shared workspace, and conventions: conventions the

users had established and how, disturbing actions from others, conventions needed, violations, views on conventions, and their effect on work styles.

Information was also used from a log of reported problems and results from the user hotline and weekly site visits of design team members. Problems were categorized using content analysis (Holsti, 1969), into the categories of: computer hardware, POLITeam/related applications, individual work practices with the system, group practices with the system, and other. Coding was checked by a second coder with 93% agreement.

POLITeam provides shared folders and email to support communication and cooperation between two units in the ministry: the writing office and a ministry unit (referred to as Unit 57, not its real name). For document production and information exchange, the shared workspace has several purposes: First, it provides shared access to documents for the writing office and the Unit 57 members. The writing office either types a Unit 57 document from a dictation or written copy, or types in modifications. The workspace also provides access to a Unit 57 text for the production of a finished copy. Second, it enables Unit 57 members to exchange documents among themselves, such as when they coauthor documents. Third, it provides access for the unit leader to all documents that have been produced within the unit. Fourth, it provides access to common information sources about the ministry, which all users update.

Conventions in a Shared Workspace

Sharing a folder in POLITeam does not support articulation work. The shared folder gives only weak indications about it's accessibility in the group[3]. Communication and negotiation are complicated because each user has her own view on the documents in the folder. In this section we illustrate some difficulties that users had in using conventions with the POLITeam shared workspace.

Different perspectives and conventions

In the Ministry, we discovered that different groups using the shared workspace have different perspectives on how to organize the same information:

1) *The writing office view:* The writing office developed a solution to organize documents: first, according to the units and then, by members of a unit. Thus, each Unit 57 member has a workspace, shared with members of the writing office. All these workspaces are contained in another folder, called the unit-folder, resulting in a two-level hierarchy. Whenever the writing office produces a document, it is placed in the appropriate unit/person workspace. This

[3] Shared objects are labeled with different background colors. This, however, only indicates multiple access points, which could be from a single user (i.e. an alias) or from several users (i.e. a shared folder).

convention for how the shared workspaces are organized is logical for the work process of the writing office: their sorting and naming convention uses the name of the document owner and date of creation.

2) *The Unit members' view:* After some time of practical experience, the Unit 57 members found that it was easier for them to organize their documents according to their work processes. They collected documents produced by the writing office in task or process-specific folders, rather than according to Unit members. Their sorting criteria for documents in the workspace was based on the content of a document, e.g. a speech on an economic issue.

With the current configuration, only the writing office convention is supported. As a typist reports[4]:

> J has many subdirectories. Each have their own special names. When a document comes from J, it is very clear to us where the document should be placed back--she writes it on the paper document....However, we can't pay attention to and can't keep track of which subdirectories everyone has.

Thus, we discovered that the users structured their information using different methods, which correspond to their work roles, i.e. whether they type documents or write content. The problem for the group arises when the different users collaborate in a shared workspace which requires one common information structure for the groups' documents. Moreover, most users use a location-based finding strategy for documents (Wulf, 1997) and some Unit 57 members reported that they could not find documents among the vast array of information in the shared workspace because the system supported only the typists' view.

Multiple perspectives are intrinsic in many work situations and call for articulation. However, the process of reconciling different perspectives for the typists and Unit members is difficult since their individual perspectives are logical for their work roles and tasks. By having different file structures, the users lack a common overview. The problem here is that although a group reference would bring benefits, the cost of achieving it is that individuals would lose their individual overview.

Convention violations

Another difficulty with using conventions is that they are often violated. We describe three examples. First, in order to provide all users with access to the latest version of documents (the writing office especially needs to retain access to the latest electronic version of the document for further processing up the ministry hierarchy), a convention was set in the second workshop that a document must not be removed from a shared folder. However, in practice, many Unit 57 members would drag the document out of the folder shared with the writing office into their task specific folder, violating the convention:

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[4] All quotes are translated from German.

> It gets on my nerves, when people don't work on their things in the writing office shared folder. In the case of substituting, when you want to get these things, then it's really difficult.

Another violation occurs with file codes which serve as common references for electronic documents; the design team developed a system prompt for the users to enter the code. Yet, this convention is violated by all but one user:

> We [the writing office] give no file code. We type in 0000. Maybe they [the Unit members] give the correct file code afterwards.
>
> If I know the file code, I give it. Otherwise I use a fantasy number [rather than look it up].
>
> They don't type in the right file code. I must correct them. I must sort the documents into the right archive. And it must correspond with the file code. And that's annoying.

A third violation we observed is with the use of a shared address list. A convention was set which required that all members update the list. The users had methods for keeping addresses before POLITeam, such as storing lists in a drawer, and their personal lists provided most addresses for them, at least enough that they were unwilling to follow a group convention. As one user explains:

> It doesn't function yet, though, since we don't have conventions for it. Each one does something else. It functions only when all the users use this distribution tool. An address list functions only when all write it into a central place. It doesn't work when each one keeps a list in parallel.

Some users reported that the shared object did not exist before POLITeam, and they did not have previous conventions to carry over to it. According to one user:

> Not everything can be carried over into the computer work...Before, the address lists were organized so that you had it lying in the drawer in your desk. Now, it's being moved from the drawer in your desk into the public workspace as a share. Naturally, technology brings changes here. But it's a big advantage, that we can bring it from the private space into the public space.

Violations among agreements per se need not be detrimental to a task, such as in responding to changes in the environment (Beck and Bellotti, 1993) or if due to "productive laziness" (Rogers, 1993). In our cases, we feel that our users were simply unwilling to follow the conventions due to the overhead. And in these three examples of violations, breaking the conventions brings additional work and sometimes annoyance to others. Providing technical means to ease using the conventions, as with the file code prompt, was also not sufficient to get users to follow the convention. They still found a way around it. This demonstrates to us a gap between the designers' assumptions of user behavior and actual user behavior (e.g. Beck and Bellotti, 1993). And setting conventions via social means in the workshops, as was done with forbidding document removal and common address lists, also did not insure that the conventions would be followed.

Despite the fact that violations annoy some users, most users report that they do not want to be controlled to follow conventions. Nor does the Unit leader want to be an "enforcer". He argues for the users to inform each other of violations in "subtle and sensible ways". In the case of the file code, there is not a clear solution to this problem, but one possibility is to try providing software to make

the file codes more available. In the case of using the shared address list, we believe it involves two factors: an imbalance in the overhead and benefits of using a shared object (Grudin, 1988), but it is also a problem concerning the lack of understanding of the properties of the shared object. One reason, as the above user mentioned, is that the address list is, by analogy to its use before POLITeam, thought of as a personal item, which indicates that the address list as a means to share is not clear for this user. However, in the case of removing the document from the shared folder, awareness information can inform group members of the consequences of their actions for the group, i.e. that removing a shared document from the workspace prevents others from having access to it.

Conventions carried over from nontechnological work

All the users have implicitly adopted a convention of distinguishing between public and private workspaces, and its use is quite similar across users. No one explicitly discussed borders of public and private workspaces. Private workspaces are respected; no one wants to search or look at anyone's private workspace, and conversely wants no one to search theirs. In the case of a person substituting, the substitute would not search private spaces. When questioned how this convention arose, many users pointed to their work practice experience before POLITeam:

> Private areas should be protected. It's good that I can't search L's desk. This corresponds to our earlier experience with our real desks.
>
> There are certainly private areas here. Such as my private workspace. If someone looks for a circulation folder here [pointing to the in- and out-box on her desk], they can search in the out-box, but not in the in-box. Similarly, what lays on my private desk, that is private.
>
> It [the distinction between public and private areas] was made very natural and implicit.
>
> It was obvious to us. The system is an exact technical reproduction of our work. You observed how work functions in the Ministry, and then you tried to reproduce it electronically. So it's no wonder that conventions used in our normal work are carried over.

This example of implicitly setting a convention shows that when the analogy is clear, conventions from nontechnological work before POLITeam can be easily carried over and applied to system use. Applying analogy from nontechnological work to technological work is a valuable learning tool, since people try to understand new processes in terms of a conceptual framework that they already know (Carroll and Thomas, 1982). In nontechnological face-to-face work, the public and visible nature of common artifacts make their uses clear (e.g. Hughes et al., 1992; Heath and Luff, 1992; Heath et al., 1993). Before POLITeam, the users had a clear distinction on their physical desks between public and private workspaces, e.g. private spaces being in-boxes or locked drawers. The visible nature of the distinction may have contributed to a formation of a common representation about public and private areas. The users apparently applied the same notion of public and private areas to their technological workspace; in fact, the metaphor itself of "shared workspace" could have facilitated this transfer.

This example highlights for us that conventions formed in face-to-face nontechnological work which may be easy to form because of the visible usage of shared objects, can be carried over and applied as conventions in a CSCW system.

Emerging work processes

A shared folder opportunistically set up between ministry departments in Bonn and Berlin now enables documents to be accessed almost immediately, whereas before POLITeam, they were exchanged via regular mail. However, this emerging work process again points to the difficulty of knowing what conventions are needed, in particular, how the shared workspace between Bonn and Berlin should be organized. Since the easy and fast transaction of information between the two locations is a new experience, it is not clear yet what documents will be exchanged. As one Unit 57 member reported:

> When we use more information together with Berlin, then we must really think what [shared work areas] would be useful. E.g. should we have things where we pack five things inside, or something else? It also depends on what it is, what kind of information. I think that in certain folders, it must be this way. It is necessary. Otherwise we have chaos. Or someone has chaos for themselves.

The nature of this introduction of a shared folder illustrates how conventions cannot always be planned at the outset of a new work process. Orlikowski (1996) cites an example of how specialists, because of their experience, were able to recognize the need for some conventions to fit an emerging work process. However, with our inexperienced users, we see the need to provide awareness of others' activities to show who is using what public information; this could help users define the conventions for the organization of a shared folder.

It is not only with emerging work processes that conventions are difficult to define. Although the users recognize the need for conventions for many procedures, most users report that they do not have a clear idea of the activities of other users. The users themselves describe the lack of awareness of others' use of shared objects as one of the obstacles in defining conventions:

> We must think over, depending on the information that we have, which shared work areas would be sufficient. But I'm not in the situation where I can see that, i.e. where I get information other than that for my own workspace.
>
> For my own archive, what I set up myself, then I can look at my own example. But for a real archive [shared], that would be set up for others, then we must really think it over; what the system offers, and what is necessary. But I can't evaluate that at this point.
>
> There's always a certain openness of doing things and a certain stringency. These are the two poles....Each one arranges their desk in their own way, and that's their freedom....The problem is that we are in an evolutionary process here--we need conventions for our normal contact with each other, our process. We need to find a balance between individual operations and conventions...There are things that must be reproducible. POLITeam's success depends on this.

The Development of Conventions

With new technology, coordination practices have been observed to develop over time in response to the changing nature of work (Orlikowski, 1996). We have also discovered through our user experience that developing an understanding of the use of a shared object takes time and also influences convention formation.

Stage	Time Span	Characteristics of stage: major problems/events
I. Learning basic functionality; mostly single-user idea of system	1st 6 months after system introduced	Problems with windows, hardware, basic computer skills: • struggling with text processing • transferring individual work practices to system • adapting group functionality to meet the group's needs
II. Discovering ways for structuring information	between 6 - 9 months	Developed own style for structuring information: • structuring information according to own work process • collecting information (finding semantic connections)
III. Developing awareness of group use of system	1 ½ years after system introduction	Developing awareness of cooperative work with system • discussed conventions for group use in workshop • discussed consequences of other members' actions
IV. Mature group working with system	?	We would expect the following: • new, unanticipated use of tools • conventions would be learned • implicit conventions would be developed

Table I. Proposed stages of user group development with POLITeam.

We have observed that since the introduction of the POLITeam system, our user work group has evolved in its use of the system. The data from site-visits, workshops, and interviews suggest that we can characterize the development of our user work group, with respect to its system use, in terms of rough stages. First, we see a trend in the problems reported at the site visits by members of the design team. The amount of problems concerning individual work practices declined sharply over time, as did hardware and software problems to a lesser extent. Early on, users requested help with their group work practices, and these mainly concerned adapting group functionality to fit their needs, e.g. setting up a shared folder or a common address list. However, in the last workshop, the users focused mainly on discussing group conventions, and it was at this time that they discussed the consequences of their actions as group members. Thus, initially, issues about group practices concerned setting up appropriate group functionality; 18 months later in the workshop, discussion about group practices concerned conventions about how to *coordinate* use of the functionality.

We have thus identified changes in attitudes toward the system over time, and even "milestones" in the system use. Through these, we distinguish stages. It is important to note that the time span of stages can only be roughly determined, since we interviewed users and held workshops at specific time points. We believe that although there was probably concurrence with some events, most

likely the stages are sequential, i.e. users could not have discussed group conventions in the workshops without first learning system basics (Table I).

Thus, the users' requirement for convention support emerged after working with the system for roughly one and a half years (Stage III). This emphasizes to us that the recognition of many conventions is associated with the process of gaining an understanding of the function of shared objects in the context of work.

Design for Conventions

In this section we present the POLITeam awareness client, a prototype system, which emphasizes the mediating role of shared objects in order to support articulation work. Rather than attempting to formally capture the notion of conventions, the system includes technical means for providing overview and shared awareness in the usage of common objects to help define and maintain conventions. These facilities can help overcome some of the convention difficulties, by providing a group context of system use; it is thus a step towards the provision of common artifacts instead of shared objects (Robinson, 1993).

Awareness support has been one of the main goals of the POLITeam project from the very beginning (Sohlenkamp et al., 1997). A special client adding awareness features through a variety of mechanisms to the standard groupware functionality has been developed (Figure 1). The client is based on the standard desktop metaphor to build on existing skills of the users. Document hierarchy and the contents of opened containers are displayed in different windows. Users have the possibility to define different views on objects regarding sorting criteria and iconic or textual display, thus allowing for individual working styles. In the following we will concentrate on these facilities and give a perspective on their influence on the support of conventions in system use.

Peripheral awareness

The system supports a non-disruptive way of displaying others activities. Users do not have to focus on the information presentation explicitly, but rather they should be able to perceive it using peripheral vision; thus, conventions are reinforced via minor user interface cues. In POLITeam, cues include the representation of active users in a workspace, color changes, and the optical enlargement of objects that are the target of others' activities (Figure 1).

Synchronous actions of other users are indicated by annotating icons with actor-symbols. The colors used in icon overlays and for the actor-symbols correspond to the role based color assignment that is used in the ministry. Over time, these cues are gradually reduced, so the most current activities are more visible than older ones. These mechanisms provide overview at-a-glance of the shared usage of objects: users can easily spot activities, while still allowing them

to work normally with their documents because the hierarchy and the relative positions of objects remain unchanged.

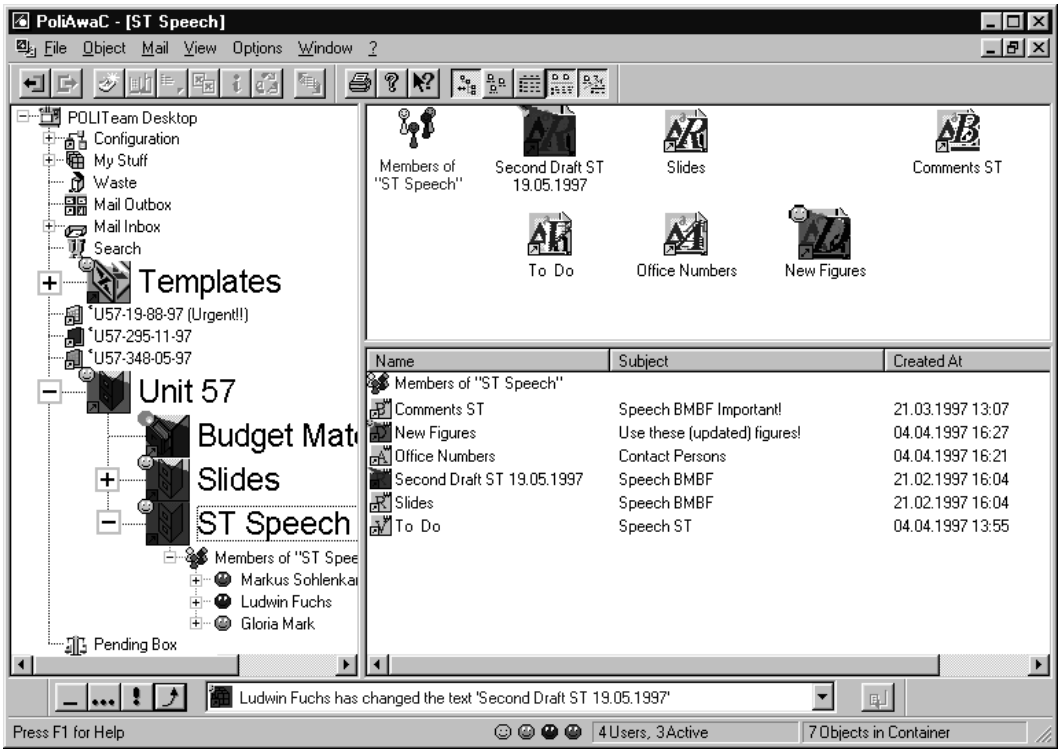

Figure 1. The POLITeam awareness client

Chronological overview is facilitated by an *event bar*, a drop-down text box, that can be opened to display the list (latest first) of all events for an object. The event bar is also used as a textual presentation medium, that always shows the latest event that is of interest to a user, displayed in the color associated with the user that generated the event. The event bar can be attached to the client main window (Figure 1), or as a stand-alone window (Figure 2). In stand-alone mode, it can be used to monitor cooperative activities, even if the working focus is on other applications.

Additionally, users can enter text in the text box, which will be distributed as a message associated with the currently selected object to all other users. This allows users to provide awareness information that cannot be collected automatically by the system (e.g., the rationale behind a convention violation). Informal communication facilities, e. g. launching a video conference, are attached to the actor symbols in the display of awareness information. In this way the system implements an intuitive integration of double level language communication.

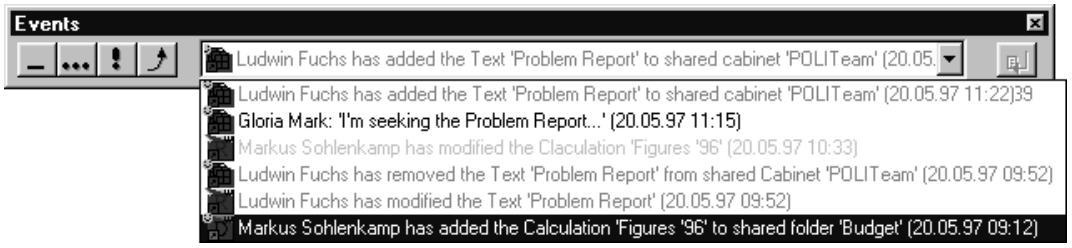

Figure 2. Expanded history list

Figure 2 shows an example how the event bar can be used to support conventions. The drop-down list has been expanded to show the complete set of current events. It can easily be determined who performed which actions on which documents. In this example, a user violated a convention by removing a document from a shared workspace. Some time later, another user reacts to this by asking for the document. This, in turn, results in the document being reintroduced into the workspace by the first user, allowing others to access it again.

Contextual awareness: supporting individual working styles

In POLITeam, the filtering of awareness information can be applied on the basis of individual work practice or on a common work practice of the group. To accomplish this, the system uses the metaphor of a situation to allow users to specify awareness profiles.

Work situation	**System provides awareness information**
"Working on the document"	when the user opens the document
"Accessing the parent container"	when the user opens the folder, that contains the document
"Accessing any parent container"	when the user opens any higher-level folder containing the document
"Immediately"	immediately, regardless of the user's current activity
"Working on the same process"	when the user accesses another document that shares the same file code

Table II. Work situations in which users may receive document-related awareness information.

An object, such as a document, defines a number of activities as well as a variety of work situations in which it may be involved, both of which can be selected by the user to tailor her personal awareness preferences to her individual work practice. Work situations are highly dynamic and need not be restricted on actions performed on the target object itself but include actions on objects that share certain relationships or similarities in terms of the application domain. Table II lists the work situations for documents in which users may receive document-related awareness information.

These details of awareness preferences can be defined using awareness profiles, which can be attached to single objects, collections of objects, or whole classes of objects. The system gives notifications about events only in situations

that conform to a user's subscribed set of profiles. In this way it is possible for users to set up their interest in awareness information in a natural way, in terms of domain specific work patterns, e. g.: "whenever I open any document I want to see what happens to other documents, that belong to the same process".

Enforcing group awareness

Awareness profiles are shared objects. Users can create new awareness profiles and jointly subscribe to existing ones. Thus, awareness profiles not only enable individual diversification of system feedback, but also provide means for reliable awareness information, by enforcing joint subscription of profiles in a group.

For example, one of the conventions concerning the shared unit folder is not to remove any object from the shared folder. To support this convention, users can use a common awareness profile for the unit folder. This profile issues a notification if a user removes a document from the shared folder. The notification situation of the profile is "Working on the unit-folder", which applies as long as a user has opened the folder. Thus, awareness about the violation of this convention is only supported among users performing similar tasks, which increases the chances to create a shared awareness about conventions. As the visibility of activities on those objects is enhanced, the group may be more likely to apply social protocols to govern their actions.

The awareness profiles allow group members to keep a balance between tailoring the information needs according to their individual sense of work practice and receiving feedback about activities of other users.

Conclusion

Conventions for using a shared workspace like POLITeam are *vast*; they encompass all aspects of operations with the system, ranging from managing shared activities to document storage. Whereas we cannot generalize beyond our users, conventions appear to be unique within a work group, and in fact, may even be unique across work groups using the same system.

The current model of organizational life is that of flexibility and learning, reflected in much research focusing on the role of the situated nature of work. Applying such a model makes sense for referring to groupware conventions: conventions are dynamic and can be unpredictable. Changes in organizational structure, work practices, and group membership all call for conventions to adapt to fit the environment. With our users, new information exchange patterns were emerging, as new shared workspaces were set up for different groups of people. Along with the opportunity to exchange information easily and fast, however, is uncertainty as to what conventions are needed in order to manage the shared workspace. With time, users can realize what information is beneficial to

exchange; the conventions will also take time to develop. Even after nearly two years of system use, the users are still discovering work operations for which conventions are needed. Conventions needed for shared archives did not become clear until a large quantity of electronic documents built up over time.

In our experience we found that some conventions failed. One reason is due to an imbalance in costs and benefits. Yet even when a technical solution was implemented to make it easier for users to follow conventions, users still found a way around them, which points to the gap between the designers' assumptions and users' behavior. The method by which some conventions were formed, via social means in workshops, could also have contributed to their failure. Workshops bring people out of their everyday work context, which has advantages, e.g. for focused training and discussion. But discussion alone does not suffice; as Gerson and Star (1986) illustrate with coordination. Grounding discussion in the work context is necessary, and in our case, it supplies the essential information for forming conventions.

Although the need for conventions may be recognized, it is not always clear to the users how conventions should be defined. When a shared object lacks the properties of clear usage, overview, and awareness of others' activities, then it is difficult for users to mesh procedures. The users themselves reported a need to understand better the work practices of the other group members in order to define the conventions. These experiences suggested to us the requirement of enhancing a shared object with additional information to make people's activities with the object visible and reproducible.

Our approach was to support conventions implicitly through non-directive technical means, by supplying users with awareness information about ongoing activities in the system, through feedback and event information. Future empirical research is called for, to track with long-term observation the effect of awareness information on convention use, as well as other social implications of convention use, such as violations, and their development in the face of emerging change.

Acknowledgements

We thank Uta Pankoke-Babatz and Konrad Klöckner for their help in our research. We also thank Wolfgang Prinz, Mike Robinson, Volker Wulf, and our reviewers for their valuable comments.

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