Changing Interpersonal Communication through Groupware Use

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Abstract: Interpersonal communication is the basis for almost any type of cooperation. Changing patterns of communication may have an impact on the quality of cooperative work. In this paper, we describe user experiences in a longterm groupware project. We examined communication changes, both planned and unplanned, as a result of the system introduction. We found reduced face-to-face communication, task-related and task-unrelated, as well as a changing dissemination of information. Certain losses in interpersonal communication were compensated for by user advocacy and design team-user workshops. We propose that with groupware introduction, organizations should consider support for both planned and informal means as compensation for reduced communication.

1. Introduction

Communication among employees plays a crucial role in organizational performance and the quality of work life. The introduction of groupware to support communication and cooperation is likely to change the way members of an organization communicate. Some applications like GDSS (Group Decision Support Systems) are explicitly designed to substitute face-to-face communication with electronically mediated communication to improve certain phases of group decision making (De Sanctis and Gallup 1987). Since the 1970's, research studies have investigated the hypothesis that communication technology could act as a cost efficient substitute for face-to-face communication. Nevertheless, evidence found in laboratory research that supports this hypothesis has not been demonstrated in field studies. Empirical studies indicated that the introduction of communication systems has, in fact, led to more complex effects (for a survey see Shulman et al. 1990).

Interestingly, the topic of changes in communication related to the introduction of groupware has not yet received much attention in the CSCW literature. In Germany, the introduction of ISDN technology into organizations has raised serious discussions because new applications (e.g. video conferencing or voice mail) and additional telephone functions (e.g. the caller's identification or the

automatic forwarding function) were expected to modify interpersonal communication (Kubicek and Rolf 1986; Berr and Feuerstein 1988; Herrmann 1989). Some expectations that grew out of these discussions include the following long-term effects of the increased usage of electronic communication systems:

- reduction of interpersonal communication during daily work
- tendencies of deprivation and formalization in communication among colleagues
- negative impacts on personal communication competencies

The authors assumed that these effects would reduce the organizational performance as well as the quality of work life, e.g. more stress caused by interruptions, less emotional engagement, reduced social relations, and the narrowing and individualization of perception of the world. Therefore, they plead for a restricted application of electronic communication systems, a conscious observation of changes in communication, and measures to avoid negative impacts. Yet to date, there has not yet been much empirical evidence for these predicted negative consequences in work life. With respect to home use of the internet, Kraut et al., 1998 found results that are suggestive that this technology negatively impacts family and social communication.

In order to contribute results to better understand the effect of introducing new technologies in real work practice, in this paper we report on a long-term exploratory study with users of a groupware system. What distinguishes this paper from previous IS studies is that we focus on the role of the communication change that was not only explicitly intended by design, but also that occurred incidentally as a consequence of the process of introducing groupware into the organization. In the long-term groupware project that we describe, we examine communication changes, both planned and unplanned, and the related consequences for cooperative work.

2. POLITeam background

The POLITeam project is a cooperative software development project intended to support ministries in the German government as they move between Bonn and the new German capital of Berlin. The main function of the POLITeam system is to supplement paper work processes with electronic work processes in a government ministry. To accomplish this, POLITeam offers a shared workspace, electronic circulation folders and e-mail functionality (Prinz and Kolvenbach, 1996). An already existing groupware system (LinkWorks) was chosen and adapted to specific user and situation requirements of three different fields of application (for further information, see Klöckner et al. 1995). The project began in May 1994, the system was installed in January, 1995, and the project ended in December, 1998.

2.1 Project Cycles

An evolutionary design approach was used, enabling modifications to be made over time, and which both designers and users reported as beneficial (Mambrey et al., 1998). Figure 1 gives an overview of the design and implementation approach. We started with a series of semi-structured interviews with potential users of the system. Scenarios describing critical work processes were derived and discussed with the interviewees. Based on achieving a common understanding of the

relevant work processes, we tailored the LinkWorks system and presented this configuration in a feedback workshop. The users were then trained and the system was installed in the different fields of application.

The users were supported by user advocates, two members of the design team who visited them regularly, solved minor problems, observed system usage, and presented their findings as input into the design processes (Mambrey et al., 1998). Workshops to discuss new prototypes and to deal with problems in system usage were also held. Moreover, once every year the users were interviewed by the project members. Based on these findings, new system versions were developed and introduced. Depending on the different fields of application, four design cycles were carried out.
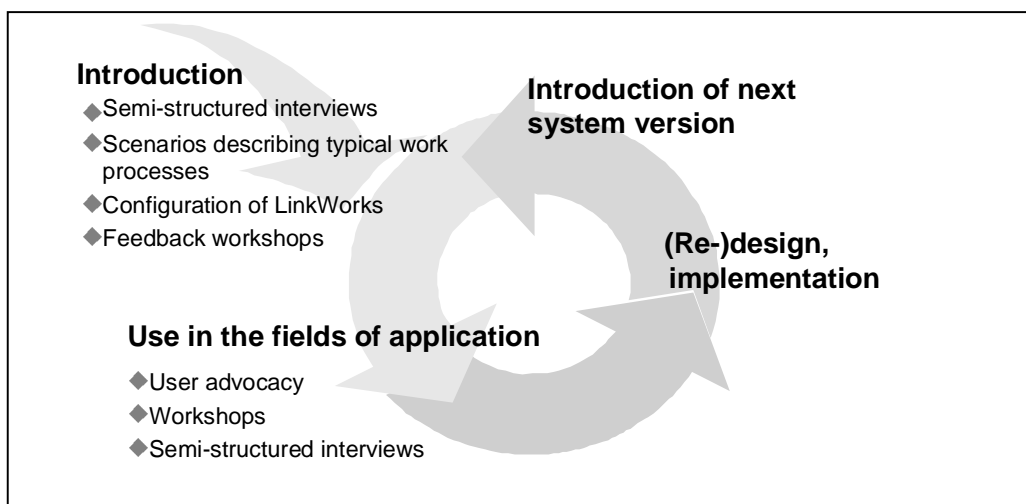

Figure 1: Approach to design and implementation taken in the POLITeam project

2.2 Fields of application

The results presented here were obtained in two different German government organizations: the Federal Ministry of Family Affairs, Senior Citizens, Women, and Youth (referred to as FM in the paper), and the State Representative Office of Mecklenburg-Vorpommern (referred to as SR in the paper), both located in Bonn. In the department where the system is installed in the FM, we find varied employee roles: one unit leader, six ministry employees (responsible for specific content areas of the ministry), and three typists in their own service unit. The employees collaborate using the shared workspace and email. Their activities include services such as responding to citizens' requests, doing tasks for the Minister, and collaborative speechwriting. In addition, the manager is responsible for activities such as information dissemination and decision-making.

In the State Representative Body there are about 30 people working who represent the interests of their state in the federal government, in the legislation process. The SR is headed by an undersecretary and the organizational structure of the body mainly consists of sections which

represent state ministries. Most of the sections consist solely of the section manager. Before the introduction of POLITeam, these sections were supported by three typists, who were a central resource. Additionally, there are several administrative sections. As in the federal ministry, the employees collaborate using the shared workspace and email. One important task of the SR consists of the preparation of the decision making within the Bundesrat, which is the second chamber of the German parliament representing the state governments. The Bundesrat meets once every third week to discuss and to vote on a list of about 80 different issues. The representative body has to prepare the state's voting on each of these issues.

The employees of the organizations that are described in this paper are working in the same building. In both of the organizations, the group members are distributed on different floors. Before the beginning of the POLITeam project, computers were used only by the typists in the FM and the SR.

2.3 Research Methodology

The results presented here are derived from a collection of material gained during the different design cycles: transcripts resulting from 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 five workshops, in which the design team met with users.

In fall of 1996, a series of semi-structured interviews with the users of the FM took place, which lasted from one to three 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. In particular, the users were asked questions specific to their interpersonal communication since the time of system introduction: had their cooperation changed, do they form agreements differently: faster or slower, do they work tighter or less closely with their colleagues, has their communication become more formal or more personal, have the amount of personal conversations changed, has the content of their communication changed, is the system often a topic of conversation, and have new words or terminology been developed among the users? All of these questions were open-ended, and users were encouraged to elaborate their responses. These same interviews were conducted with users from the SR in the fall of 1997. Information was also used from a log of reported problems and results from the user hotline and weekly site visits of design team members.

3. Communication and the process of articulation

In organizational communication, a distinction can be made between formal and informal means. These categories are grounded in organizational theory and are used with different meanings. Kraut et al. (1990) state that informal communication is the residual when rules and hierarchies are eliminated as a means of coordination. Thus, any ad-hoc coordination is based on informal communication, which is spontaneous, unplanned in nature, and rich in content. Grochla (1973) has a more specific understanding of this term. For him, informal communication is not directly related to the work task but rather oriented towards social confirmation or emotional engagement. Though Grochla's distinction bears some analytic merits, we follow Herrmann (1991) who argues

that it is practically impossible to categorize communication in this way. Any speech act being mainly socially or emotionally directed may have an impact on the way tasks can be carried out. On the other hand, task-related communication always has a social function.

Informal communication is important for developing task-related and social processes in a group. Changes in communication can impact cooperation in general, and in particular, the process of articulation work. Articulation work is the effort to clarify, negotiate and mesh different perspectives, so that the group can carry out the cooperative task. Especially with heterogenous groups, articulation work is necessary to resolve the different specialized activities, opinions, perspectives and interests that group members assign to shared objects (Star and Griesemer 1989). The difficulty in coordinating interdependent work is that different perspectives can affect the handling of shared information, such as when different users establish different storage schemes in a groupware system (Wulf, 1997). Devising a unique method for storing shared documents affects all the users involved. 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). Due to the situated nature of work, articulation must also take local contingencies into account; informal communication plays an important role for this purpose.

In addition to informal communication, other means can be used for articulation. Monitoring others' actions can also be a part of articulation work in that it can facilitate the understanding of shared object use (Heath and Luff 1992; Hughes et al. 1992). The articulation process can also be mediated through technology as visible coordination mechanisms such as organizational charts, project plans, or vacation schedules, are replaced with electronic mechanisms, such as electronic calendar systems. Rogers (1993) reports on how group members interacted using a whiteboard in a common office as a mediating mechanism for checking out files; this procedure enabled each persons' activities to be visible to the group.

In the next section, we present examples of some effects that electronic work has had on interpersonal communication in both the FM and SR. We argue that such changes, which indicate that face-to-face communication becomes reduced and more limited, adversely affects the articulation process. As a result, designers need to consider alternate means to supplement articulation; in section 5 we discuss the notion of planned communication channels, implemented in the project.

4. Changes in Interpersonal Communication

In this section we present examples showing how communication has changed in the government ministries as a result of introducing the groupware system. The results illustrate how groupware has led to a reduction of informal communication, leading to both positive and negative effects in the work experience.

4.1. Reduced face-to-face communication with colleagues

Reports from the users indicate that employees experienced reduced face-to-face communication and we present different examples which represent these changes. In the first set of examples, a unit member from the SR and secretaries from the FM report how the usage of certain groupware functions has reduced occasions for interpersonal communication among colleagues. In the second set of examples, employees report how they experience less face-to-face interaction with their manager, which results in more impoverished feedback about their work.

For one employee in the SR, due to the introduction of electronic document exchange and email, the nature of his interaction has changed from informal verbal face-to-face communication, to more formal written communication. Before POLITeam was introduced, the SR unit member reported how he interacted more with his colleagues by meeting them in the hall, but also through meeting others at the typists' office. The members would bring their work personally to the typists, often to try to persuade the typist to give their work priority. The typists' office in this sense became a sociopetal space, i.e. a social gathering point. However, since the introduction of POLITeam, this user comments on its impact:

> The communication with colleagues is faster, due to communicating over the PCs. The personal contact has been reduced. My colleagues ask me, I haven't seen you for a long time. I am hiding behind this computer. Before we met often by the typists' desks, handing our work to them. Now we meet seldom.

With the introduction of the system, now this employee and many of his colleagues type most of their documents by themselves. As a consequence, they have less need to go to the typists' office, resulting in fewer occasions for face-to-face contact. Although this user spends less time socializing with his colleagues, the indirect impact of the groupware on his work practice is that he spends more time on work. He estimates that he saves twenty-five percent of the time that he formerly spent on face-to-face communication with colleagues and secretaries. As a result he claims that his task performance became more effective. Nevertheless, the network of informal communication seems to have weakened.

Not only do employees of the SR report having reduced contact with each other, but typists in the FM report this as well. Whereas before the system introduction Ministry members would have to be dependent on the delivery schedule of a courier service, employees now have immediate access to the typed documents. As soon as their work is finished, the typists place the documents into the shared workspace, and through an awareness service, the employee is notified that the document is available. Further, for minor changes, employees now make corrections themselves. The typing process has been streamlined by the introduction of the shared workspace and the described awareness notification service. The latter service saves overhead for the typist of having to send emails to inform unit members when the work is completed. Thus, not only is the personal contact less, but even written email communication is now replaced with automatic notification.

One employee describes how her interaction with the typists and Unit leader is changed as a result of being able to send documents electronically :

My relationship with the typists has changed. They can put things in my closet, and I can pull it out right away. I have access rights. I can also send things directly to the Unit leader, and they are there at once. Or when a colleague sends something, it's there right away....

Similarly to this employee, two years after the introduction of POLITeam, another employee of the FM reported how the cooperation with his manager has changed. The manager of this section is responsible for about five employees who work mostly independently on different tasks. However, the manager cooperates with individual employees. This manager, with long experience in the ministry, is responsible for all of the activities carried out in his section and must sign most of the outgoing documents. The story of the change in relationship can best be described by the employee himself[1]:

Many things are now handled through the exchange of mail and attached documents which before were discussed face-to-face. For instance, when I had to prepare a meeting of the workgroup, in earlier times I created a hand-written paper indicating the tasks I thought needed to be carried out. Then I asked my boss for a date to meet. At that meeting we discussed the tasks. Starting with the list, we often discussed other topics. Sometimes it happened that we forgot to speak about a certain issue on the list.

Now I type the list of tasks into my computer and mail it to M (the manager). He types in his comments in a different color and sends the electronic document back to me. By means of this procedure the cooperation between us has improved and is more efficient in 80% of the cases.

This procedure has led to the fact that we are talking less during the preparation of a meeting of the workgroup. I work more autonomously. I think M appreciated this mode of cooperation, too. Nevertheless, it happens occasionally that I move into dead ends which would not occur if I communicated more intensively with M. From his long experience, he judges 98% of the cases appropriately. In these cases a lot of work gets lost.
....
Talking face-to-face to him, I always get good ideas. A lot is communicated from the expression on his face. Now something gets lost.
....
Since the introduction of POLITeam I talk less with my colleagues and M. Important information is getting lost. In earlier times, this information was communicated in personal talks. Occasionally this does not happen anymore. I realize that I have become more passive in looking for personal communication. I need to pay attention that this behaviour does not occur too often.

This user is expressing at the end that the value of the face-to-face meeting served to facilitate the conversation, in particular by getting feedback and helping him generate ideas. And again, consistent with the report of the user described earlier, at the same time the use of groupware has made work more efficient. Thus, less face-to-face communication also appears to impact work conducted between employees and their manager.

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1 The quotations are taken from a protocol written on the day of the interview, translated from German by the authors.

Another user in the same FM department corroborates how her interaction with the same manager is now also reduced. Before POLITeam, she would meet with the unit leader to review changes in a document. They would discuss the changes and then she would return to her office and write them down. However, the user and the unit leader now share a workspace. When they collaborate on a document, the user lays the newest version directly in the workspace and an event notification informs the unit leader. The unit leader now mostly writes his changes directly in the text, and the two do not meet so often together. Yet to her, the reduced contact between cooperating partners is an advantage:

> When one is under pressure and only holds personal conversations, then it is an advantage if one can communicate with another electronically. It lasts shorter and saves one a lot of energy.

She is also not bothered by the reduced social contact, explaining "*We are not in danger of isolation".* She reports that there are perhaps fewer conversations, but when one wants to speak with another, they do it. Still another user agrees with these reports and explains that informal verbal face-to-face communication with his colleagues is reduced about 10-20%. Contrary to her colleague, this user appreciates the effectivity gains without reporting about negative long-term effects of reduced face-to face communication.

Yet an interesting footnote to this change in communication practice is that users also report that to some extent, the content of their communication has changed. Not surprisingly, they have occasions to interact with colleagues when someone has questions about the system or about what they had just sent. The typist from the FM reports especially that users come to her with questions on system use. The typist is the most experienced computer user in the department; before POLITeam, she had already been writing documents electronically with a word processor.

Thus, what these user reports suggest is that face-to-face communication with colleagues (and with one's manager) is reduced, while the efficiency of work (as measured by transaction time of documents) has increased. Some users claim a loss from the decreased social contact.

4.2. Redistributing information in the communication chain

As a result of introducing PoliTeam in the SR, the process of communication involved in preparing the state's vote in the Bundesrat has changed considerably. In essence, a paper-based coordination mechanism has been replaced by an electronic one (Schmidt and Simone 1996). This process innovation has considerably affected the communication and the way information was disseminated within the organization, as described in the following case (Wulf 1999).

Prior to PoliTeam use, a standard paper form sheet was used as a means to record each minister's vote, for each issue of the agenda. This was a formidable task; as described earlier, the ministers must vote on about 80 different issues every three weeks. The forms were consolidated and recorded on another standard sheet. One section manager was mainly responsible for each of these issues. He marked the issue on the form sheet and filled in a voting proposal of his section after consulting the minister that he represents. Furthermore, he wrote down the name of other sections of the body that will be involved in the decision-making.

Before the groupware introduction, the form sheet was printed on paper and the responsible section head personally carried it to the colleagues to secure their votes. If they were in their offices, their voting proposal could be marked directly; otherwise the form sheet was left on their desk. After one section head had recorded a vote, the sheet was brought back to the person responsible, who distributed it to the next section head involved. Finally, all the form sheets were given to another section manager who was responsible for coordinating the outcome with the state chancellery. Due to the fact that section heads were often out of the office, it sometimes required a lot of work for the people responsible to assemble the completed form sheets.

This process was modified after the introduction of POLITeam. The paper-based form for recording votes became an electronic form. The manager who is responsible for a voting issue now creates a new form for each issue, and sends a link to this document via e-mail to all the section managers who are involved in voting on this. When all sections have filled in their votes, the manager then sends a link via e-mail to the colleague who has to coordinate the outcome with the state chancellery. This colleague, as coordinator, collects all of the form sheets and mails them to the state chancellery where they are used to facilitate the decision making among the different ministries. Thus, what was formerly a sequential voting process prior to the groupware introduction has now become a parallel voting process which is done electronically.

The effect of this innovation was that it reduced the face-to-face communication among the section managers. This problem was pointed out by a section manager who stated that before introducing the electronic procedure, his colleagues dropped into his office to ask for his vote on specific issues or to deliver their form sheets. Even if it was not possible at this time to meet with them, the section manager would meet with them later on when they brought the form sheet back to him. In the case when he was mainly responsible for an issue, he had to go to others' offices to secure their votes. The value of such face-to-face contact, as he reports, was that he would get full and detailed verbal explanations of the reasons behind the votes. These verbal explanations enabled him to prepare his report for the section manager's meeting with the undersecretary. Moreover, these visits were occasions to start talking about other topics and even private matters. Describing himself as a rather shy person, the section manager avoids going into other peoples office without a specific purpose. Thus, he is now missing occasions to converse with his colleagues.

To compensate for this loss of information with the electronic voting process, the section managers established the convention to type in a short explanation to accompany their vote. Nevertheless, one of the managers claims that he often cannot ascertain the reason for the vote from this written explanation. People write mainly what the vote is, but because they are now communicating in written, rather than verbal form, they do not describe the reason for the vote in much detail, information that the manager reports is critical. The limited written explanation also creates more work for the manager because he must use this explanation to accurately report on the issue later in his meeting with the undersecretary. In sum, one consequence of the reduced

face-to-face contact is that less information is exchanged about the votes. And the information that is exchanged is less critical. As the unit leader expresses:

> The reasons for the decisions of the Federal Parliament cannot be explained in a relaxed way in personal conversations any more. Before a large amount of informal information was exchanged. Now everything must be written down in detail.

Nevertheless, the employees of the state chancellery, who are at the end of the communication chain, are very satisfied with the new mode of communication. Before, they relied completely on the verbal explanation of the section head. Now the typed comments, though incomplete, are a permanent record for them, and this is a benefit. Thus, the section head, the intermediary along the communication chain, loses in the new (written) electronic communication process, whereas the state chancellery members, at the end of the communication chain, benefit from the new electronic dissemination of information. Because of the permanence of the written communication form, more information survives along the communication chain.

5. Planned Communication Change: Establishing New Channels

While these changes in communication processes could not have been foreseen at the onset of the project, nevertheless planned channels of user-user communication were implemented, more formal in nature, set up at the FM. Whereas at the beginning of the project we could not predict how user-user communication would change, the cooperative design approach in the project required setting up a channel of communication between designers and users (see figure 1). Interestingly, these channels turned out to become an important means to encourage communication among the users. One of their intended goals was to aid users in the articulation process, particularly in agreeing formally upon conventions for system usage (Mark et al. 1997; Wulf and Mark, 1997). The fact that users developed some individualized conventions in the course of system use suggests to us that whereas formal channels of communication are necessary to start articulation processes, the carrying out of articulation needs further supplementation in an informal, continuous basis.

5.1 Communication channel oriented to the group: user workshops

The first planned communication channel that was opened for users was through the establishment of regular workshops held every six months where the design team and users met together face-to-face. The goal of most of the workshops was the presentation of newly developed prototypes to the users. While they were intended to stimulate user-designer communication, they also became an important means to stimulate discussion among the users. Initially they dealt with system design and configuration. In the course of the project, problems emerging due to the collaborative use of the application became an increasingly more important subject of these workshops.

During the workshops, users were confronted with scenarios, and could discuss problems and requirements so that they could learn commonalities and differences in their handling of the

system. Importantly for managing different perspectives, conventions were discussed and negotiated, e.g. concerning naming conventions, document storage, shared tasks, borders between public and private work, access rights, and substitution rules. Thus the workshops were a means to orient the users to group work as opposed to individual methods of working. In this way, articulation was supported. The workshops were facilitated by the user advocates, described next.

5.2 Communication channels oriented to individual work practice: user advocacy

The second planned communication channel was established between the users and the design team, via user advocates. Because the potential interaction with users could be extremely high in such a large-scale project, especially when the design team was composed of a number of members, it was decided to "channel" the access to users, enabling them to concentrate on their work. The user advocates did active user services, visiting the users' site every two weeks, watching and advising the users while they were using the system in their normal working environment. This gave the user advocates the opportunity to continuously learn from the users' work practice. As communication conduits from the design team, they communicated information about system use to the users, and were able to spot discrepancies in perspectives and work practices, e.g. differences in naming conventions (see Mambrey et al., 1997 for a more detailed description of their activities). The user advocates also served as channels of communication from users to designers; they reported the users' proposals and requirements during design workshops and made design decisions jointly with the designers, adopting the users' point of view.

6. Discussion

From a longitudinal study of the groupware usage, we have uncovered some evidence that the communication has changed among the users in both government organizations, the SR and FM. Three factors which led to a change in interpersonal communication became clear:

- the change from physical to the electronic exchange of documents reduced occasions to meet (e.g. voting form sheet, typed papers)
- electronic media replaced task-related personal communication (e.g. the FM manager electronically annotates documents instead of communicating his comments face-to-face; SR employees type in explanations for a vote)
- the reduced division of labour resulting from the introduction of groupware led to less mutual dependencies in cooperation (e.g. employees now work more independently, employees type or correct certain document changes themselves, whereas before groupware they relied on the typists to do the changes).

6.1 The role of informal communication change

Due to the fact that documents are transported electronically, employees report that they find less occasions to meet with each other face-to-face. Since most work can be carried out electronically, people tend to stay in their offices, lowering the occasions for spontaneous, task-unrelated communication. Moreover, the possibility to exchange and annotate documents electronically in some cases has reduced the necessity for planned task-related face-to-face communication. The

employees experience this new mode of cooperation as being more efficient. Nevertheless, it shows that occasionally information important for the current task is not communicated any more. Compared to communicating via writing (i.e. written annotations on shared documents), face-to-face discussion obviously offers many more opportunities to articulate work. As task-related and social and emotional aspects of communication are inseperably interwined, these changes in task-oriented communication may have long-term effects on the social network, as well (Herrmann 1991).

In some cases, the introduction of groupware has led to a reduced horizontal division of labour (Wulf 1999). This type of organizational change reduce the interdependencies of different units and therefore the need for communication as a means for coordination. These changes are not problematic as long as the necessary coordination needs are addressed and the required social network remains. This is especially important if new tasks come up which require tighter cooperation. On the other hand, the introduction of groupware leads to new cooperative activities centered around the system. For example, support networks established among employees provided occasions to contact each other directly (Wulf 1999). Thus, means can exist to compensate for losses in direct communication. Though not intended to fulfill this purpose, the planned communication channels of user advocacy and user workshops played a similar role. Both of these interventions resulting from the cooperative software design approach in POLITeam provided opportunities for face-to-face communication. Nevertheless, the communication focused instead on system design and cooperative use of the system.

Moving from face-to-face towards electronically mediated communication also affects the dissemination of information within organizations (Orlikowski 1996). In many cases it will create uneven gains and losses for users of the technology (Grudin 1989). As the case of the SR indicates, electronic annotations on documents are less rich in content compared to face-to-face explanations. The consequence of written vs. verbal explanations is not new; it has long been characterized that speech affords an advantage for communicating details fluidly (e.g. King, 1995). On the other hand, written explanations are a permanent record, and may reach a wider audience. Though lacking a context may increase the risk of misunderstandings, in the case of FM and SR users, people received this written information who might otherwise not have, and they appreciated having the data. Further, the electronic annotations are one-way communication; there is no feedback concerning the quality of explanations. Because of the written medium, and because of the lack of feedback, the explanations are sparse, and not suitable for the section head's needs. And yet it is costly for the section head to return again to the face-to-face communication of votes, the method used before PoliTeam.

Articulation work plays an important role in an organization where shared data must be exchanged between different actors. In face-to-face interaction, there are many opportunities to observe how others are handling the data, and to reconcile one's behavior to enable congruent handling of shared data. However, when users are working remotely, or when electronic communication lowers the chances for face-to-face meeting where observations or discussion about work can occur, then we might expect articulation work to suffer. We found some evidence that this is the case. The reduced contact in the SR during voting has led users at the front end of

the communication chain to provide sparse explanations about the vote. Not only is less reasoning about the vote communicated, but also less peripheral information about the context in how the vote was derived. This information is vital in communicating about one's work, i.e. the process by which one goes about securing a vote. The same is true in the case of the employees who meet less with their manager. The manager sees the product of the work, i.e. the list of tasks, but the process information of how the tasks were derived is lost. At the same time, meeting together to plan the tasks affects the quality of the product, according to one employee. This process information is vital to share in cooperation, in order to aid group members in the coordination and development of conventions for their work.

6.2 Planned channels: single-user vs. group orientation

To some extent, the planned channels of communication recovered some of the lost process information, although it remains incomplete. First, the process information was not captured in the course of work, but was rather relayed at specific time points: when the user advocates visited, or when workshops were held. Second, the process information that was recovered was subject to biases: those of the users reporting them, especially some time after events occurred, and those of the design team members who elicited them. Yet a main advantage of user advocacy is that the advocates were able to gain an overview of the users' work and discovered discrepancies among the users' handling of the groupware functionality. As in a cross-pollination process, they acted to spread information from one user to another.

Different types of requirements were elicited from workshops and from the user advocates, during their site visits. First of all, many of the problems and requirements that emerged during user advocate site visits concerned single-user handling of the system, e.g. a requirement to set up a personalized document template collection, or a request to adapt the interface. Problems concerning group practice at the site visits were also discussed, but again were geared to the individual usage of the group functionality, e.g. learning how to set up an address list in the shared folder, or problems in not receiving notification of events that occurred in the shared workspace.

In contrast, communication at the workshops concerned *coordinating* the use of the functionality. The workshops offered an opportunity for the users to meet face-to-face to discover how others were handling the shared objects. In the course of discussion, the different positions and perspectives of the users became clear, and conventions could be negotiated; this was a way for people to establish a group context. Workshops were well suited for discussions about conventions, which need to occur in a participatory way at a group level.

In sum, the formal channels of communication served several purposes. They served to compensate for the reduced user-user communication in the daily course of their work. This was mainly through the workshops, where the focus was on the group use of the system. The communication between users and user advocates served as a way for users to express individual requirements and problems. In this way, the advocates could facilitate the convention-making process by identifying individual perspectives.

Compared to the information lost due to reduced informal communication, the information disseminated by the user advocates and exchanged during the workshops focused more on the groupware system. This is due to the fact that these measures were taken as part of a cooperative software development process. Nevertheless, they indicate an approach to handling impacts of changing communication due to the introduction of groupware. Yet additionally, organizations need to address how groupware users can establish new means to create ongoing informal face-to-face communication. Where social methods may not be viable, technical means such as awareness support might prove effective. Though time consuming, our experiences suggest that an increased productivity of labor will be the reward for such a research effort.

6.3. Informal communication as maintenance and clarification of articulation

We argue that while planned communication channels for remote users appear to provide promise for developing articulation, at the same time, attention must also be paid to the change in informal communication that occurs on an ongoing basis with colleagues, in the sense that Herrmann (1989) described. Based on our findings, we propose a new role that informal communication plays: *the continual maintenance of articulation processes that are applied in practice.* The role that planned communication channels play is limited; they can be valuable in establishing articulation processes, such as identifying that conventions must be formed. But a wide gap exists between establishing articulation processes, and their continual maintenance in actual work practice. In this sense, informal communication as a means of articulation serves to provide continuous feedback to users about their work practice, enabling them to adjust and refine their workstyles in order to achieve a common group understanding of work.

How such informal communication might be encouraged or supplemented needs further research. Social methods such as facilitation by the users (Austin et al., 1990), or mediators (Okamura et al., 1994) have reported some success. On the other hand, technical support via awareness has also been proposed as a means to provide peripheral and contextual awareness (e.g. Mark et al., 1997) as well as helping users to overcome discrepancies in their use of the system (Simone et al., 1999).

7. Conclusion

In this paper we have presented evidence suggesting that along with the introduction of the groupware system in two areas of the German government, face-to-face communication has been reduced. Whereas one might expect such communication changes to occur in a less structured organization, we feel it is somewhat surprising to find such changes in a hierarchically structured government organization. In the first case, reduced communication has been reported to impact social life, and elaboration of work, e.g. the generation of ideas with one's manager. In the second case, reduced communication has resulted in a cost for a manager who must try to reconstruct the limited explanations for votes that he receives in written form. In contrast, planned channels of communication have compensated for the negative effects of the reduced occasions for face-to-face meetings. In our case these interventions into the normal pattern of communication were

mainly caused by the cooperative design approach. Therefore, they stimulated a very specific communication content among the users. Nevertheless, the integration of planned channels into the informal pattern of communication seems to make sense as an approach for addressing problems resulting from reduced communication. Planned meetings within workgroups or departments whose setting encourages informal communication may strengthen the information flow within organizations. Another way to encourage informal communication in a planned manner is through the architectural design of office buildings when it incorporates sociopetal spaces as gathering points. Further research is required to investigate how planned channels of communication can overcome certain losses in informal communication in the workplace due to the transition to electronic work. We believe that the topic of emergent changes in communication is one that should gain more attention in the CSCW community.

There are limitations to our results. First, we can only report experiences from a limited number of users. The work of the users is specific to government administration, and their experiences may not be generalizable beyond this work domain. Second, we have only investigated the use of one specific groupware application. It would be interesting to learn how other systems such as video-conferencing or collaborative virtual environments would impact informal communication. Third, we have only reported user experiences based on interviews, workshops, and site visits. It would have been beneficial to have additional measures to track more finely the frequency of communication over time. Nevertheless, we feel these results are valuable since there are few longterm studies conducted focusing on groupware use. In our case, the users had used the system in their work for three years.

These changes in communication affect the quality of work life as well as the efficiency of the technologically supported work processes. Such changes in communication will probably become more severe if work processes are more comprehensively supported with technology and individual workload increases related to organizational change (Pipek and Wulf, 1999). In our study, the planned channels of communication were used during the prototyping process. An open question remains how groupware practitioners can deal with the negative consequences of such changes when the prototyping process has ended. Therefore, it is important as well to consider how additional planned channels of communication can be incorporated for the longterm in an organization.

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8. References

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