

Appropriation and Re-Appropriation of Groupware: Theoretical and Practical Implications of a Long-term Case Study

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Abstract. This paper provides a long-term case study of a groupware's appropriation¹ in a German state government. The study covers the lifecycle from the groupware's introduction to its removal. We also examined the consecutive re-introduction of another groupware application. During a period of about five years, the field of application offered us the opportunity to gain deep insights into personal, organizational and technical aspects of a groupware's appropriation and *re-appropriation* (the appropriation of a similar but different technology for the same purpose). We have used these empirical data to contribute to the theoretical framing of the appropriation process of groupware. Special emphasis is given to approaches based on Structuration Theory. Discussing existing conceptualizations, we contribute to a better understanding of organizational change processes induced by the appropriation of groupware. Focusing on the removal and re-introduction phase, we also discover new requirements for the design of groupware platforms.

¹ We use the term "appropriation" in this contribution in its general meaning, referring to the active part users play in designing the use and usages of technology. We are not referring to the specific meaning of this term in the context of the theories discussed later.

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1 Introduction

Groupware is applied in different types of organizations. As a consequence of practical experience, the CSCW community has become increasingly aware of the intertwined relationship between groupware usage and the structure and culture of organizations (e.g. Wulf and Rohde 1995; Button and Sharrock 1997; Hepsoe 1997). The introduction of groupware is often related to the processes of organizational change. From an economist's point of view, the introduction and the change process can be measured by evaluating whether they improve the given work processes, increase the quality of the output, or offer new options for future development. However, looking at the case studies presented in the literature, we find success stories as well as major failures even when introducing the same kind of applications (cf. Lloyd and Whitehead 1996; Karsten 1999). Different experiences indicate that the way a groupware is introduced, related to organizational change processes, is a crucial success factor. Therefore, it is worth investigating organizational change related to the introduction of groupware in theory and practice.

With regard to theory, we focus on approaches which are based on Giddens' Structuration Theory. We use the results for a longitudinal case study to evaluate these theoretical approaches. Describing experiences from the POLITeam project, we present a complete lifecycle of a groupware application, from its introduction to its removal. Extending an earlier report (cf. Pipek and Wulf 1999), we also cover the re-introduction phase in which a new groupware is applied with the intention to replace the old one. In widening the scope of observation from one tool to an infrastructure, we introduce the concept of *re-appropriation*, the appropriation of a similar but different technology for similar tasks. Re-appropriation is an interesting phenomenon to observe and to discuss in the context of technology-related organizational change processes. Based on the empirical findings, we discuss how groupware is appropriated and how organizational change processes, which lead to a beneficial assimilation of groupware technology in organizations, can be stimulated. We also report on possible problems and obstacles for these processes. Our findings also induced new requirements for the design of groupware platforms.

This paper is structured as follows: First, we give a survey of the theoretical discussion dealing with the interaction between groupware technology and organizations. First we describe the research setting and methods referring to our case study. Then we take a closer look at the core work processes in the field of application. Using the groupware lifecycle phases as a structure, we describe the main experiences gained. Finally, we discuss our findings with regard to theoretical as well as to practical implications.

2 Interaction between Technology and Organization

Ciborra (1996 and 2000) described the difficulties in understanding the dynamics of groupware usage, and the more or less uncontrolled “drifting” of information infrastructures in organizations. The appropriation, removal, and re-appropriation of such infrastructures present an interesting empirical case in this context. From an action research perspective, it challenges us to understand the potential of organizational transformation.

2.1 Theoretical Concepts

To analyze a groupware's use in a long term perspective and the organizational change processes involved, theories dealing with the relation of organizational and technical factors need to be considered.

Research within the last forty years indicates that approaches focusing on the impact of technology on organizations did not generally generate applicable results. These approaches were based on the assumption that technology has a general impact, i.e. that the introduction of a certain tool must necessarily lead to specific effects. Crowston and Malone (1988) called such a perspective the ‘*technological imperative*’. A refinement of this stance assumes that the effects of technology depend on certain conditions. This school of thought is called *the contingency theory*. It conceptualizes the impact of technology on organizations in a more sophisticated manner than the general technological imperative perspective. However, it is hardly less deterministic. The technological imperative has been challenged by the viewpoint that people act purposefully to accomplish certain objectives and according to their intentions they choose the technology they need. This view is called the *organizational imperative, strategic choice, or planned change perspective*. However, the influence of an existing technological infrastructure on human decision making and planning is not taken into account in this school of thought (cf. Andriessen, Hettinga, and Wulf 2003).

Due to lacking explanatory power of technological and organizational imperative perspectives, an interactionist perspective is dominant nowadays. It is based on the idea that changes emerge from the unpredictable interaction of people, context, and technology (Crowston and Malone 1988). The proponents of such an interactionist school of thought apply different theoretical frameworks to ground their analysis, namely the Structuration Theory (cf. Orlikowski 1992, 1996b, and 2000; DeSanctis and Poole 1994; Karsten and Jones 1998; Karsten 2003), the Activity Theory (cf. Nardi 1996, Kuutti 1996, Redmiles 2002, Törpel et al. 2003) and the Theory of Self-Organizing Social Systems (cf. Wulf 1999). In the following we will focus specifically on those interactionist frameworks which are grounded in the Structuration Theory.

Giddens' Structuration Theory (1984) is an attempt to overcome the fundamental division within the social sciences between those who consider social reality as a product of human action in the light of their subjective interpretation of the world, and others who see them caused by the influence of objective, exogenous social structures. Giddens proposes that structure and human

action should be considered, not as independent or conflicting elements, but as a mutually interacting duality. Structures are created by human action, and then serve to shape future human action. This is called the principle of *duality of structure*, i.e. social structures are both the medium and the outcome of interaction.

Though Giddens' Structuration Theory does not treat technology explicitly, the duality of structure has been perceived as an important concept to ground an interactionist framework for analyzing the effects of technology on organizations (cf. Jones 1999). This attraction stems, as we see it, from two triggers: (a) technology can be seen as an important aspect of structure which interacts with human action (b) the interaction between structure and human action is conceptualized in a non-deterministic way, i.e. the outcome of this interaction can not be anticipated beforehand.

However, one finds different conceptualizations with regard to the structuring role of technology on human action. Due to its potentially high impact on human action these conceptualizations have been discussed very intensively with regard to groupware. In her earlier work Orlikowski (1992) assumes that structure is implemented into technology during the design phase. The structure implemented into the functionality of an application interacts with human action during the usage phase.

DeSanctis and Poole (1994) developed a framework which allows an analysis of the impact of technology on organizations. They differentiate Orlikowski's (1992) notion of structure embedded in technology. Social structure provided by a groupware is conceptualized in two ways: the "structural features" and their "spirit". The structural features characterize the way the functions are implemented in the system. So social structure stays, at least partly, embedded inside the technical artifact. Moreover the concept of spirit is introduced.

"Spirit is the 'official line' which the technology presents to people regarding how to act when using the system, how to interpret its features, and how to fill in gaps in procedures which are not explicitly specified. <...> Spirit is a property of the technology as it is presented to users. It is not the designers' intentions - these are reflected in the spirit, but it is impossible to wholly realize their intents. Nor is the spirit of the technology the user's perceptions or interpretations of it - these give us indications of the spirit but are likely to capture only limited aspects." (DeSanctis and Poole 1994, p. 126).

The "spirit" should be reconstructed by the researcher based on an analysis of artifacts such as the system's interface or training material, and additional interviews with designers and users. By introducing the concept "spirit" the authors indicate that they do not consider the implemented functionality to be the sole source of social structure imposed by a groupware.

In breaking with her earlier applications of Structuration Theory, Orlikowski (2000) revokes the assumption that social structure is implemented within the technological artifact during the design phase. The change in her theoretical perspective is due to empirical findings as well as to a reconsideration of Giddens'

theory. Referring to empirical findings on the use of different technologies, she argues that people modify technologies and their conception of technology long after design and development. When reconsidering Structuration Theory, she points out the fact that Giddens (1989) rejected the idea to conceptualize structure as being something outside or external to human action, as something that could have form and shape by itself. In reformulating her earlier conceptualizations, Orlikowski (2000, pp. 406) believes that only those properties of a technology, with which a human actor interacts frequently, contribute to the ongoing process of structuration. So the recurrent social practice produces and reproduces a structure of technology use. The social structure of technology use is emergent and not embodied in a stable manner. Even if the structure of technology use may become institutionalized over time it is only a "stabilization for now". A new structure can be enacted at any time. However, the social structure emerging from a technological artifact is not fully arbitrary. It must be understood as being related to the artifact's functionality.

2.2 Organizational Transformation

Theories conceptualizing the relationship between organization and technology are of high practical relevance. They allow one to find appropriate approaches to stimulate organizational change related to the introduction of groupware. Traditionally, approaches which deal with organizational changes related to the introduction of technology are grounded either on a technology-imperative or on an organizational-imperative perspective.

Roughly speaking, there are two different approaches in the CSCW literature for introducing groupware. The first one, which we call "technology first", focuses on the new technological options groupware offers. The decision makers in the organization - often from IT departments - employ the groupware technology without explicitly and actively addressing issues of organizational change. Perhaps they just want to gain experiences with a technology which is regarded to be important for the organization's future and its further potentials for development. An example for such an approach is the appropriation of electronic calendars in two major computer companies (cf. Grudin and Palen 1995; Palen 1997). "Technology first"-approaches may also have an organizational change perspective. In this case, organizational change is seen as determined or enforced by the given technology. Such approaches are grounded in the school of thought we called "technological-imperative".

In the second sort of approach which we name "organization first" organizational objectives are dominant from the beginning of the introduction process. Management typically initiates and implements changes in the organizational structures and its work processes to improve an organization's performance or fit with the environment. Groupware technology is introduced to support organizational changes with adequate information and collaboration

infrastructures. An example is presented by Turrell (1996). He describes how groupware has been introduced following the decision to reorganize a multinational company around profit centers. These approaches are grounded in a school of thought which we called the "organizational imperative".

In the approaches above, organizational transformation is the result of a planned and purposeful intervention. It occurs rapidly and discontinuously. A rather short period of change disrupts longer periods of organizational stability (cf. Orlikowski 1996b). Contrary to these approaches, interactionist approaches, especially those which are grounded in the Structuration Theory, conceptualize organizational transformation related to the introduction of groupware as an on-going change process (cf. DeSanctis and Poole 1994; Orlikowski 1996b; Karsten and Jones 1998). The recurrent social practice produces or reproduces the social structure of technology use permanently (cf. Orlikowski 2000).

Taking such a perspective, the meaning of organizational change has to be extended. In addition to just focusing on purposefully planned interventions, unintended, subtle and slow changes in the actors work practise need to be regarded. Orlikowski and Hofman (1997) suggested an early classification of organizational transformation following the introduction of groupware. Transformations can be distinguished by two dimensions:

- (a) whether the change is anticipated at the moment of the groupware introduction, and
- (b) whether it is planned and realized purposefully.

"Anticipated changes" are organizational transformations, which are being planned the moment the groupware is introduced and realized purposefully. "Opportunity-based" changes are not anticipated when introducing the groupware. However, when their potential is discovered, they are realized in a purposeful manner. "Emergent changes" are not anticipated when the groupware is introduced and emerge through decentralized unplanned activities.

2.3 Empirical Studies

There are only few in depth studies which have followed the organizational appropriation of groupware technologies over longer periods of time (cf. Törpel, Pipek and Rittenbruch 2003; Hettinga 2002; Ciborra 1996 and 2000; Wulf 1999; Ngwenyama 1998; Karsten and Jones 1998; Hepsoe 1997; Biksen and Eveland 1996; Orlikowski 1992b and 1996). These studies are crucial to investigate the interaction of groupware technologies with organizational processes. Among the different groupware applications, Lotus Notes seems to be the one whose organizational effects has been most intensively investigated. Other studies deal with group decision support systems and video-conferencing applications.

With regard to research methodology, most of the studies look at the appropriation of a single application in one specific organizational setting. Such

studies are fundamental in shaping our understanding of appropriation processes and in identifying factors of relevance. Another approach is taken by studies which try to identify factors of success or failure throughout different organizational settings. A study by Huysman et al. (2003) compares the appropriation of the same video conferencing application across different settings. In a survey article Karsten (1999), compares studies dealing with the introduction of Lotus Notes and classifies them according to their organizational effects.

These studies focus on observing the appropriation of one specific (groupware) tool. But today the classical groupware functions (messaging, file sharing, awareness, video conferencing, etc.) are often covered by a multitude of technologies and tools, which build a technological infrastructure (cf. Hanseth and Lundberg 2001). This infrastructure is challenged by every new tool and technology users gain access to, and there it may be (locally or organization-wide) enhanced if the technological innovations are estimated as being useful. This results in a perspective in which a changing technological infrastructure undergoes a process of continuous appropriation. Pushing the focus of our analytical perspective beyond the scope of one tool and its appropriation results in interesting opportunities for empirical work. It gives us the chance to understand the dynamics of competing technologies (and their appropriations!) in an analysis of technology-related organizational change (Törpel et al. 2003, Wulf 1999). Finally, it strengthens our awareness of time and history, which offers opportunities to gain insights into technology-related organizational change by observing consecutive appropriations of technologies for the same or similar tasks by the same players. Therefore, we took the opportunity to accompany an organization through the appropriation of a groupware, the groupware's removal, and the re-introduction of a different groupware.

Analyzing *re-appropriation*) seems to us an interesting way to discuss appropriation models based on the Structuration Theory. It allows one to investigate the effects of different functionalities on the emerging social structure. The transition period when moving from one system to the other seems to be of special relevance. One would hope that the different theoretical concepts of technology-related structuration could be evaluated.

An investigation which deals with the replacement of a groupware application through another is also of high practical relevance. The higher the penetration of groupware within organizations and the longer these applications are in use, the more likely it becomes that one groupware will be replaced by another. Such findings may also be transferable to other classes of computer applications.

Though obviously of high theoretic and practical relevance, we do not know of any case study which has investigated the replacement of one groupware by another. The replacement of a groupware in a real organizational setting cannot be planned in the beginning of a study. Therefore empirical findings, like the ones presented in the following are the result of favorable circumstances.

In the following we will present a long term case study. It covers the introduction, the organization appropriation and the removal of a groupware, until finally a new groupware application is introduced.

3 Research Setting and Method

The case study deals with computer supported cooperation in political administration. After the German parliament had made the decision to move a big part of the federal government from Bonn to Berlin, a research initiative was launched to develop tools for distributed work in the political administration. In this initiative, two research institutions and an industrial partner were supported by research grants to develop groupware solutions.² To find out appropriate design requirements and to evaluate prototypical solutions, two organizations of the political administration were involved: a federal ministry and a state government.

The POLITeam project followed a “technology first” approach. It started as a software development project in which the applying organizations wanted to gain experience with tools to support distributed cooperation. In the beginning of the process, there were not any plans for organizational transformation.

The case study reported here took place in the government of a Northern German state. In this contribution we focus on work processes connecting the state government located in the state's capital with the Bundesrat (cf. figure 1). The Bundesrat is the second chamber of the German parliament representing the 16 states. It is located in the federal capital, at that time in Bonn. The State Chancellery (SC) plays an important role within the state government. It channels information from and to the different state ministries. Within the State Chancellery one organizational unit (a head and three employees) is responsible for the coordination of the different state ministries within the process of political decision making. The State Representative Body (SRB) is located in the federal capital. In the SRB about 30 people are occupied with representing the interests of their state in the process of federal legislation. The SRB belongs to the State Chancellery. The SRB is responsible for transferring documents and distributing information between the state government and the Bundesrat. A detailed description of related work processes will be given later.

Before the beginning of the project, only some employees of the state government were equipped with computers. Network-PC's were mainly used by typists and secretaries. Thus, the SRB had no IT-department of its own, because the IT-department associated with the SRB belonged to the State Chancellery in

² The German National Research Institute for Information Technology (GMD-FIT) and the University of Bonn were research partners in the POLITeam project. gedas, the IT branch of the Volkswagen cooperation, was part of the consortium as the industrial partner. Both authors worked during the project at the University of Bonn.

the state's capital, 700 kilometers away. When problems occurred, they asked for IT-support from another state's Representative Body in the same building.

The software development process was based on an off-the-shelf groupware application: LINKWORKS™ by Digital. It was introduced in the government administration of the state and its SRB in the federal capital. The features of the system offered shared workspaces, electronic circulation folders, e-mail (including electronic document transport), and basic awareness services. The groupware was based on a client-server architecture.

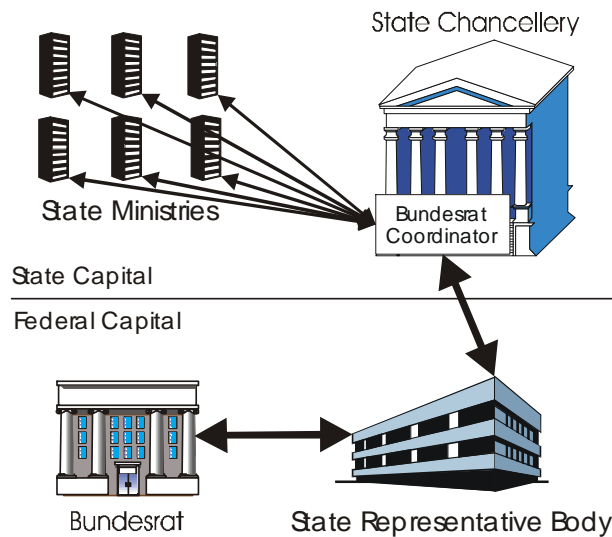


Figure 1. Organizations and Information Flow when preparing a section of the Bundesrat

An application programming interface allowed extensions of the groupware system. Starting from LINKWORKS, the research institutes and the industrial partner developed new system versions evolutionarily according to the specific requirements of the users. Cremers et al. (1997), Mambrey et al. (1998), and Prinz et al. (1998) describe the cooperative design process in more details.

The project started with a series of semi-structured interviews with nearly all potential users in order to learn about their work practice. The interviews were conducted jointly by researchers and consultants from the industrial partner. The interviews were transcribed and used to create textual scenarios describing typical work processes. The industrial partner tailored the LINKWORKS application according to the requirements found and presented it to the users of the different organizational units in training workshops. After eight months, the system was introduced. During the introduction phase users were supported with daily site visits by researchers and consultants. Over the following four years of usage project members visited the different sites twice a month for a full day to provide individual support to every user. A telephone hotline was offered to the users as well. When necessary, researchers and a consultant from the industrial partner facilitated workshops to discuss organizational problems. Once a year the researchers conducted semi-structured interviews with selected users in order to investigate topics such as training and support, individual and collaborative work with the system, cooperation and usage of information, search facilities, awareness of others and conventions. The results presented in this paper are based

on a collection of transcripts from interviews, site visits, telephone hotline calls, and workshop discussions. The authors were engaged in different roles during the project: as interviewers, facilitators of discussion groups and providers of system support.

The last phase described in this paper, took place after the research project had ended. Relations to the application field were sustained on an informal base by the authors. Final interviews (problem-oriented narrative interviews) and a small workshop was conducted about five years after the project started. Due to a major re-organization, many of the people we had been working with in the SRB left the organization, and further research was not possible.

4 Preparing a session of the Bundesrat

We will now describe the main work processes of the SRB in the federal capital as they were given in the beginning of the project. The description is based on the initial interviews. It also reflects additional findings we gained during the early usage phase. These processes represent the core activity of the organization. Other activities, for example the organization of events or the writing of press releases also involved groupware usage (e.g. collaborative text writing) at a later stage of the project. However, they will not be discussed here.

The main task of a SRB is the management of the information flow between the federal and state capital concerning the legislation procedure in the Bundesrat. The Bundesrat meets every three weeks to discuss and vote on an agenda of about 80 different issues. The SRB and specific sections of the State Chancellery and the state ministries cooperate in determining the state's vote on each of those issues. As the state was governed by a coalition of two parties, which opposed each other on the federal level, the decision concerning the state's vote on an issue in the Bundesrat occasionally required complex negotiations. In preparing a session of the Bundesrat, we distinguish four different, but closely connected work processes.

The first work process is referred to as *Issue Distribution*, which deals with the distribution of information material from the Bundesrat to the appropriate sections of the state government. The treatment of an issue begins with printing the federal

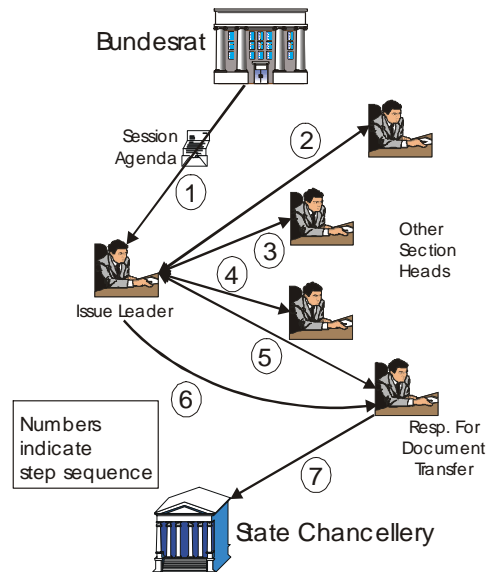


Figure 2. Vote Preparation Process

government's proposal in the print shop of the Bundesrat. It is sent via courier service to the SRB. After the registrar takes out some copies for internal use, the remaining ones are sent to the State Chancellery by another courier. There, more copies are taken and sent to the state's ministry of internal affairs via courier. Finally other couriers bring the documents to all other ministries involved in that issue. The document transport takes three days. Any other transport of documents between the Bundesrat and the state government works in a similar manner.

The second work process prepares the negotiation processes which leads to the state's vote. We call this one *Vote Preparation* (cf. Figure 2). Two weeks before the meeting of the Bundesrat its different commissions (e.g. commission for internal affairs) meet to discuss and vote on the different issues of the next agenda. An issue is typically handled in several commissions. The state is represented in each commission by one employee of the SRB who typically is the head of the corresponding section in the SRB. After the meetings of the commissions a personal protocol including main discussion points and results of test voting is hand-written by each section head and passed to a secretary for typing, followed by further correcting and re-typing until the result is satisfactory. Then it is sent by fax to the corresponding state ministry. At the same time, a secretary of the Bundesrat writes an official protocol about each of the commissions' meetings and sends the paper document via the SRB to the corresponding state ministries. Within the commissions each state ministry acts independently by means of the corresponding section of the SRB. To coordinate the different ministries' activities, concerning one issue of the agenda, the SRB invented a coordination mechanism (cf. Schmidt and Simone 1996) based on a form sheet. This coordination mechanism works as follows:

For each issue, one section of the SRB takes main responsibility (issue leadership). The issue leader creates a hand-written form sheet for each issue for which he is responsible. He marks the issue and gives a rough political judgement. He adds the result of the test voting in the commission of the Bundesrat, for which he is responsible. Finally he states the names of other sections of the SRB, whose commissions also deal with that issue. On the form sheet he leaves space for the other sections to add their comments and their commission's test vote. This form sheet is typed and printed by a secretary, and re-checked by the issue leader who then carries it to the heads of the other sections involved in order to get the result of their test votes. To reach the heads of each section, this process may require several attempts, being that the section heads are absent quite often. Finally, all form sheets are given to one section head who is responsible for collecting and sending them by fax to the section of the State Chancellery which is responsible for the coordination of the state's activities in the Bundesrat. The deadline for the arrival of the papers is always on the Tuesday before the meeting of the Bundesrat, which typically leads to high time pressure in completing the papers.

The Chancellery uses the form sheets to get a survey on the state of political process and to recognize inconsistent activities of different ministries.

The third work process (*Vote Negotiation*) mainly takes place in the State Chancellery. The state's vote is now negotiated at the government level. Having identified possible conflicts between different ministries, the employees of the State Chancellery contact the conflicting ministries, identify the political dissenter and try to find a compromise. Inside each ministry, there is a section responsible for the coordination of Bundesrat activities. To coordinate the negotiation process, those sections have to contact other sections in their ministries which are responsible for specific issues. The negotiations continue the next following days. In the State Chancellery the negotiation results are summarized for the state cabinet which finally decides how to act on each issue in a meeting three days before the session of the Bundesrat. The options are either to agree, to disagree, to abstain or to suggest a modification of the given issue proposal. The results are then transmitted via fax to the SRB where they are used to prepare the Bundesrat session (negotiation with other states, additional test votes, etc.). If the cabinet decides to propose a modification concerning one of the issues on the agenda, the modification has to reach the Bundesrat two days before the meeting. These proposals are formulated in one of the ministries, sent to the SRB for a formal correctness check, approved by the State Chancellery and finally sent to the Bundesrat through the SRB via courier. This process has to be carried out within one day, so the documents usually are sent by fax, which lead to frequent retyping of the whole text.

The fourth process is the so called *Session Preparation*. The day before the meeting of the Bundesrat the modified proposals from the other states are sent to the State Chancellery and ministries. The state government has to make up its mind on how to react upon the proposed modifications by the next morning, so this coordination task is under extreme time pressure, as well.

5 The lifecycle of the groupware

The term lifecycle is often related to an acknowledged model distinguishing more or less distinct phases, e.g. product lifecycle models in marketing (Kotler 1980) or the software lifecycle in software engineering (Sommerville 1989). We do not rely on such models, because there is neither a model representing a groupware lifecycle, nor is there enough empirical data to build one. However, we apply the metaphor “lifecycle” to provide a temporal structure for presenting the case study in more detail.

In this paper, we roughly distinguish four phases introduction, use, removal, and re-introduction. The introduction phase covers the analysis of the work processes and the identification of processes, which should be improved with the help of the new tools. Moreover, it deals with the installation of the groupware

and related qualification processes. During the use phase, the appropriation of the new technical infrastructure takes place by the organization. Technical fine-tuning, adjustment to new external developments, discovering and implementing organizational innovations, and qualification measures for new users are activities during this phase. The removal phase begins with the decision to remove the groupware infrastructure or to change to another groupware product. It caves activities such as saving data and realigning work process. During the re-introduction phase a new groupware is applied. This phase is similar to the introduction phase. However, it is based on given expectations and experiences. Data has to be reintegrated and work processes need to be aligned to the new system.³

The introduction of Groupware into the SRB started quite early about three months after the project started. It could - for the SRB - be considered as completed about 15 months later. The subsequent usage phase ended about three and a half years later, when the decision for the removal had been made. The groupware application was de-installed within three months, by December 1998. In 1999, after the project had ended, another groupware product was introduced. We believe that the observation of such an extended life cycle offers interesting insights from a theoretical as well as from a practical perspective. In the following we will describe important organizational changes in the phases that occurred.

5.1 Introduction Phase

The SRB in Bonn got equipped with hardware and software by the end of 1994. Due to problems with the hardware infrastructure, the corresponding unit of the State Chancellery was equipped more than a year later.

As a result of the initial interviews and analyses of the work processes before the introduction, two major problems became apparent:

- - The transport of paper documents from the Bundesrat via the SRB to the state government was very time consuming.
- - The typing of protocols and other documents by secretaries was a bottleneck for the SRB's activities. As all the sections of the SRB worked in the same rhythm, it created peaks in the secretaries' workload of the secretaries, causing a significant prolongation of processing time. Additionally, the section heads judged the typing quality to be rather bad.

Therefore the groupware application was deployed among the secretaries, the registrar and those sections, which wanted to be equipped with computer support. There was no organizational pressure on the staff members to participate in the

³ We do not use the terms "appropriation" and "re-appropriation" for the phases here in the description part of our contribution. This is to stress that the application field was dependent on external decisions throughout the whole process we observed.

introduction of IT. As the Bundesrat already provided most of its documents electronically via a X.400 message transfer system, the industrial partner equipped the groupware with a X.400 interface at the registrar's workplace, which accelerated the reception of documents considerably.

We started to deploy LINKWORKS and MICROSOFT OFFICE applications by means of a one-day workshop, where participants could explore system functionality guided by a trainer. The trainer focused on presenting the functions, which he estimated to be important for supporting the work processes identified before. After the training, the systems were directly installed on the users' desks. During the first week, members of the project team were constantly present in the SRB for answering questions and supporting system usage. Additionally, a hotline was established during working hours and task-oriented handbooks were provided for the users.

5.2 Usage Phase

After the introduction project members visited the users about every second week. At these occasions users got additional training, were supported in solving technical problems, and had the opportunity to ask for new groupware functions. It turned out that these visits were major occasions to coordinate cooperative work among the section heads and between them and their secretaries. Moreover, process innovations were developed at these occasions.

5.2.1 Task Shifts

The first effect of the groupware assimilation was a dramatic decrease of the workload for the typists. Those section heads and staff members who were equipped with a computer, either started typing their texts themselves or gave the manuscripts to the typists only for the first draft, while they entered the corrections on their own PCs. Although most staff members were not able to type very fast, the elimination of correction-retyping-cycles and faster document transport shortened the time for text production. The acceleration of the text production was judged to be a significant advantage by the section heads involved.

When the project started there were three full positions in the typing pool. After one and a half years of groupware usage, only one part-time position remained. Since typists left the SRB rather often due to bad payment, the decline of the typists' workload did not lead to active discharges. Positions which became vacant were not filled again, but were moved to other sections of the SRB. A reduction of typists had also been observed in the federal ministry during the POLITeam project (cf. Wulf 1997).

The support offered by the project members was not enough. During everyday work, many questions - mainly concerning the OFFICE products - came up. On

these occasions immediate help was needed. Little by little, the registrar who showed more knowledge and interest for computer usage than others took over the role of a local computer expert and provided the support needed. Soon after the introduction the increasing workload concerning computer support impaired his regular work too much. It took a longer discussion with the administrative head of the SRB and strong support by the project team before he was finally compensated by the addition of half a secretary's position to his section. The registrar was also interested in administrating the groupware server in the SRB. The SRB benefited from these activities because administrative changes could have been carried out more quickly. However, the administrative head of the SRB did not see any necessity for allowing the local support to take the required Unix courses. He did not understand enough about groupware to see the immediate and long-term advantages and feared that these additional tasks would cause a raise in the local expert's pay scheme.

5.2.2 Process Innovations

The work processes Issue Distribution, Vote Negotiation and Session Preparation within the SRB changed in two ways. First, since the process of document production was conducted by the users themselves, they found that process speed as well as the quality of outputs had improved (the latter due to less misunderstandings). Second, the use of electronic documents offered faster document transport and easier handling (e.g. copying) of document distribution. The Issue Distribution process Especially underwent slow but constant changes during the four years, since more and more external sources and documents were made available electronically by the cooperating organizations. So the Issue Distribution was increasingly based on electronic networks, gradually replacing the paper-based document flow.

The work process Vote Preparation underwent more significant changes (cf. Figure 3). It was also improved through the effects described above, but the main improvement came with the parallelization of the sequential process part. Neither the project members, who had conducted semi-

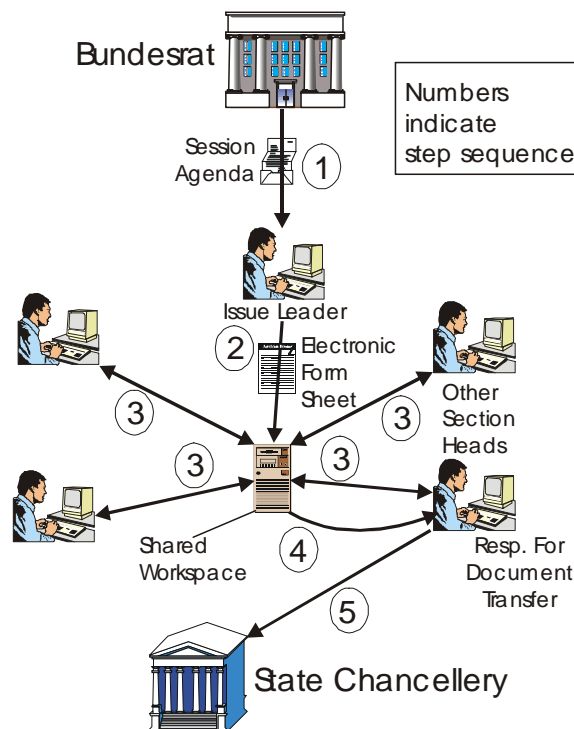


Figure 3: Vote Preparation revised

structured interviews with the users before introducing the system, nor the users themselves, having been taught about the features of the application, directly recognized the potential for process innovation. During a site visit several months after the introduction, a project member and a section head discussed rather accidentally the stack of "form sheets" (see description of the Vote Preparation process) on the section head's desk. As a result of their discussion they came up with the idea that the process of filling out the "form sheets" could be supported by the object-sharing feature of the groupware. They involved other section heads to discuss their idea and work out an electronically supported procedure.

In the new procedure, a document template, represented by the form sheet is stored in a public folder. The issue leader can copy it from there and fill it out for the specific issues for which he is responsible. He can enter his commission's test

voting results and further comments. A link to the document is then sent via e-mail to all the other section heads being involved in that issue. The recipients can enter the vote of their section whenever they like. Because of document sharing, it is not necessary to maintain a temporal order, but it is not possible for two users to access the same document simultaneously. When all sections contributing an issue, have entered their votes and comments, the issue leader sends a link to the completed form sheet via e-mail to the section head responsible for transferring the documents to the State Chancellery. So the shared workspace of the LinkWorks system allows one to overcome the sequential order to fill in votes, which was immanent in the paper based version of the Vote Preparation process.

5.2.3 Groupware Distribution within the Organization

At first, only those users, who voluntarily agreed to use groupware products, have been included into the introduction process. The improvement of the Vote Preparation processes, described above, boosted groupware usage among the section heads significantly. When the reorganized process was implemented, the available workstations had to be redistributed among staff members according to the needs of that process innovation. The other staff members, especially those with administrative functions, got equipped later, due to the restrictions imposed by the tight IT budget of the SRB.

Not all users, who had the groupware installed, actually used it. One of the section heads still asked the (remaining) secretary to type the forms for the Vote Preparation process for him. He also made her handle the groupware supported data exchange for him. Since she only had a part-time position this slowed down the process. It took more than two years until the section head finally started to use the computer by himself. The head of the SRB was another example for a very reluctant attitude towards groupware usage. The major motivation for her, to finally participate, was certainly not an intend to improve work processes. She felt that a new field of activity had risen in "her" organization, in which she was not involved. Thus, other than peer pressure (cf. Grudin and Palen 1995), the fear of being excluded from what ones' subordinates played a role in groupware appropriation, as well.

5.2.4 Social Aspects

The organizational changes also altered social aspects of work life. While the local expert in our case liked his new role, the typists did not welcome the task shift. Due to that development described above the last remaining typist feared that her position would be endangered, too. To make herself indispensable, she began storing macros and document templates outside the groupware application on her local directories. This caused breakdowns in collaboration when she was on vacation, and endangered the system security when computer viruses spread

around. To get rid of the viruses, the local expert cleaned up only the server assuming that all infected files were stored there.

Other outcomes arose from the improvement in the Vote Preparation process. Usually, when the section heads went around to collect the votes, they talked to each other about private, as well as business issues. This had been a valuable occasion for informal communication. Although there were still opportunities for floor talks, some staff members missed those occasions (cf. Mark and Wulf 1999).

5.3 Removal Phase

Near the end of the project, the situation in the application field became complicated. The state's government had changed, so that there was quite some fluctuation among staff members. In the State Chancellery the IT department got more involved in the POLTeam project. Until then they had not taken part in the selection of the groupware product, had not run the technical infrastructure, nor had they provided support to the users. Now the IT department started to worry about the time after the research project's end. It developed plans to implement a standardized groupware solution for all state government authorities. The users of the SRB favored LinkWorks as their technical infrastructure for cooperation, which resulted in an intra-organizational conflict. However, the groupware system and the underlying hardware infrastructure had grown technically out of date.⁴

In that situation the heads of the SRB, of the State Chancellery and of its IT department failed to agree upon a joint strategy to maintain, or further develop the given groupware infrastructure. The head of the SRB had changed following a state election which resulted in a change of government. The new head was not familiar with the electronically supported work processes and had different priorities. So he did not stress pushing the SC's IT department towards a solution in fit with the SRB's work processes. Approaching the end of the POLITeam project, in October 1998, the IT department of the State Chancellery decided to change to another groupware platform, because it already relied on the network products of this specific groupware manufacturer. It soon became clear that it would take a few months until the new infrastructure would be in place. As the SC's IT department regarded it to be too dangerous to rely on the old, from now on unsupported groupware, the SRB had to work with a temporary solution, based

⁴ LinkWorks was originally developed by a small Austrian software company. To gain a better market share – especially internationally – LinkWorks was sold to Digital. As part of their cooperation, the Austrian company was contracted by Digital on rather generous terms to develop new system versions according to Digital's specifications. When Digital ran into economic problems, LinkWorks was not considered to be part of its core business. To economize, Digital finished the cooperation with the Austrian company. It decided to develop new LinkWork versions in-house. However, it took time before the new development team was able to become productive. At the same time Digital's marketing efforts with regard to LinkWorks got weaker. Finally, after the end of the project, LinkWorks was taken from the market.

on the existing hardware in the form of stand-alone-PCs. The option to map the shared workspaces of the groupware on the shared directory service of the operating system was rejected. Parts of the network hardware were de-installed. It was considered to be too difficult to establish the necessary conventions (e.g. computers offering shared directories should always be online) and the access rights seemed to be too complicated to be handled by ordinary users.

We are now going to describe some issues concerning the groupware de-installation process and the work situation after de-installation.

5.3.1 Technical Issues

The biggest technical problem to solve was to assure that the documents stored in the groupware server's database and file system remained available. Therefore, a project member wrote a program based on the groupware's application programming interface to export the documents. But due to different naming conventions between the groupware (long filenames) and the operating system (filenames restricted to eight characters), it turned out that this process could not be carried out fully automatic. So, it became a very time-consuming process. The users had to rename files with long names before a member of the POLITeam project exported them. In case they had not prepared the export well, they had to rename it individually. After all, documents were finally stored on the stand-alone PCs of their creators.

5.3.2 Difficulties with Metaphor Transfer

Several problems occurred concerning the use of the operating systems directories. The groupware worked with office metaphors like "desk", "cabinet", "folder" or "document". Some users were not able to generalize from these container metaphors and had significant difficulties using ordinary directories as a means for structuring their documents. Navigation in directories was also considered by the users to be more difficult.

The groupware had offered the concept of "document patterns" to be reused e.g. for standard letters. By opening one of these patterns, the pattern was first copied, then the copy was opened. With the ordinary file system, it was possible to overwrite a pattern accidentally with an instance of it. This caused considerable problems among the users.

5.3.3 Communication and Collaboration Breakdowns

The PC at the registrar still served as the X.400-Gateway of the organization. But since the groupware's messaging system was missing, all information had to be printed before it could be passed on to the relevant sections. This took considerably more time, and the gateway became a bottleneck for inter-organizational communication. The head of the section for European politics, for instance, had established an intensive document exchange with colleagues from

the Representative Bodies of other German states, which she now was not able to sustain. Other staff members returned to the former practice of faxing documents. They heavily complained about busy lines and a clumsy handling of documents. Due to the missing document sharing functions, the need for text retyping occurred again, but now with significant less support by typists. Collaborative text production survived however some users now transferred documents via floppy disks which proved to be a continuous source of mistakes and misunderstandings.

5.3.4 The Breakdown of Process Innovations

Since the groupware was not available anymore, almost all of the four work processes changed drastically with regard to the usage phase. The Vote Preparation process now returned to being mainly paper based (cf. Figure 4). The issue leaders created the form sheet on their PC, printed out a sufficient number of copies and distributed them to the other sections. When the sheets returned, they typed the remarks of all of her colleagues into their final version, printed it and passed it on. This caused an extra burden upon those section heads who were the “issue leader” for many issues.

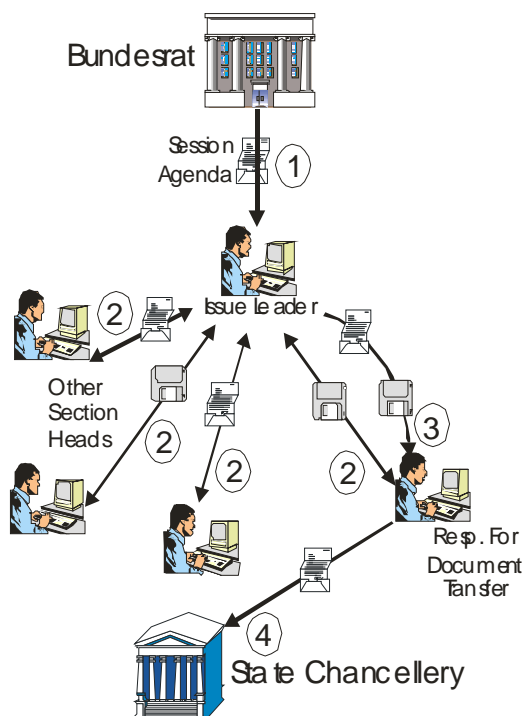


Figure 4: Vote Preparation without Groupware

Since all electronic documents which come in from outside the organization had to be printed, the staff member at the X.400-Gateway was no longer able to handle the full workload anymore. Information flows had to be prioritized, and finally the only process which remained - at least in parts - supported by electronic document transport, was the Issue Distribution, since incoming papers from the Bundesrat were still forwarded to the State Chancellery. For all other processes, documents were then transferred via fax again.

5.4 Re-introduction phase

The work practice was so closely connected to the technical infrastructure that the quality of the work processes and their outcome suffered significantly from the groupware removal. So, after the POLITeam project had ended, pressure from the

section heads confronted the SRB administration with the problem. Negotiations between the administration of the SRB, the SC's IT department, and the administration of the State Chancellery were conducted to speed up the introduction of another groupware product.

The decision for the specific product - NOVELL GROUPWISE 5.2/5.5 - was made by the IT-department of the State Chancellery, which was used to work with Novell networks. There was no effort taken to check whether this choice was appropriate for the state government in general and the SRB in particular.

The introduction of the new groupware system lasted from January to March 1999. Together with the groupware, five new computers were installed using WINDOWS NT 4.0. All computers were connected based on Novell network protocols. The old machines were not capable of running WINDOWS NT, which led to a heterogeneous structure of operating systems in the first place, and as a consequence, the installation of the groupware in two versions: GROUPWISE 5.2 on the old WINDOWS 3.11 machines, GROUPWISE 5.5 on the new NT computers.

To introduce the new groupware to the users, two workshops were conducted by the IT-department lasting two hours and three hours. Not all users were able to take part in the workshops since the SRB staff was not involved in arranging the data. The workshops focussed on the groupware's time management capabilities, since this was considered to be the major advantage of the selected groupware compared to competing products. In addition, one of the local experts received a two-day training course on Novell-based networks.

The new groupware product significantly differed from the old one.⁵ While the latter was based on a central database realized on groupware server, the first mapped shared network directories to groupware workspaces. The new product did not use office metaphors like "desk", "folder" or "closet", but applied more technical terms. The messaging functionality did not allow sending links to documents, but only the documents themselves.

Since every shared workspace of the groupware required a shared network directory, the number of workspaces, usable at a workplace, was limited by the number of disk drive letters used by the WINDOWS operating systems to distinguish hard drives as well as shared network directories. By convention, „G:“ became the drive letter for the individual user's working directory, „I:“ was used for the central repository of document patterns (now based on the word processor's capabilities), „J:“ was used for a public workspace and „K:“ was used for all coordination activities concerning the preparation of a session of the Bundesrat. Where necessary, subdirectories were created, but it was not possible to specify specific access policies for them. For example, a subdirectory was created, for every session of the Bundesrat, containing one file for each issue on the agenda.

⁵ The differences and problems described here refer to the older version of GROUPWISE (resp. to WINDOWS V5.2 based on 3.11), since this became the most common denominator for cooperation in the SRB.

Overall, users were satisfied with the fact that a new technical infrastructure was available. However, they found their new work environment being worse than the old groupware. Work practice was developed so that most users accessed the shared network drives directly through their operating systems' file managing tools, not through the groupware. The groupware was only used for reading and sending messages. The calendar management tools which had been focused on during the training sessions were not used.

5.4.1 Viewing groupware as part of an infrastructure

Some of the difficulties which arose during the introduction of the new groupware system show that it is important to perceive groupware as a part of a whole IT infrastructure. Most of the groupware products only make sense if they are used together with other software applications. We already mentioned that the MICROSOFT OFFICE Suite had been introduced together with the POLITeam groupware. These applications were essential because they allowed to create, read, or modify the documents shared by means of the groupware.

The interrelation of the different systems develops dynamics which affect the success of a groupware's introduction significantly. In our case, we can detect two aspects which complicate a solution of the problem of groupware re-introduction: technological heterogeneity and implementation shifts.

The heterogeneity of the hardware led to different operating systems. This factor caused a heterogeneity of the applications respectively application versions, not only with regard to the groupware, but also with respect to the MICROSOFT OFFICE Suite. This led to problems because users working with OFFICE 97 under WINDOWS NT had to remember to store text documents in the format of WINWORD 6.0 for compatibility reasons. They frequently forgot this, which hindered document sharing and affected the success of the groupware. In their subjective perception users did not distinguish between the different applications; they only noticed that the problem had not existed with the old groupware system.

Problems also resulted from a shift in the implementation of concepts. In our case, both infrastructures provided the concept of shared document templates. However, the implementation of this concept differed. In the old system, the concept was provided by the groupware, which automatically created a copy of the template when the user opened the document. In the new solution, the concept is realized by means of the document template function of the word processor. With the old infrastructure it was impossible to overwrite a template by mistake, with the new solution it was. Overwriting by mistake continued to happen. These problems had already started to occur during the removal phase.

5.4.2 The relevance of implementation details for process innovations.

The innovation concerning the "Vote Preparation" process was re-implemented almost exactly the way it was described in the "Usage Phase" chapter (cf. Figure

5). The only difference was the usage of shared network directories instead of shared workspaces.

However, problems resulted from the missing “link” concept in the new groupware application. Instead of passing a link, the issue leader now had to pass a description of the directory location where the actual electronic form was stored. When an issue had been postponed to the agenda of a later session (which happened frequently), the issue leader had to move the related electronic form sheet into the subdirectory of the session it was now supposed to be discussed in (not necessarily the next session). Using the old groupware application, the issue leaders did not have to inform their colleagues about any relocation. In the new directory based version of technical support, the description of the electronic form sheet’s location became obsolete in case the sheet was relocated. This frequently led to mistakes with every one, be it an issue leader who forgot to email the new location to colleagues, or a section head who forgot about the new location.

This case shows how disruptive small differences in the implementation of similar function can be. Such breakdowns caused by mismatches in the users’ perception of the function can endanger existing process innovations. Inappropriate implementations of groupware functions may also have a negative impact on the initial implementation of process innovations. It is questionable, whether the process innovation would have been as successful if a groupware platform had been introduced in the beginning which was not compatible with the “link” concept.

5.4.3 Mapping work and tools, tasks and function

Our experiences suggest that it is not sufficient to present a tool’s features to users to stimulate appropriation. The users were used to the basic services of a groupware with which they had years of work practice. Their work tasks did not change during the transition from the old groupware to the new one. All these

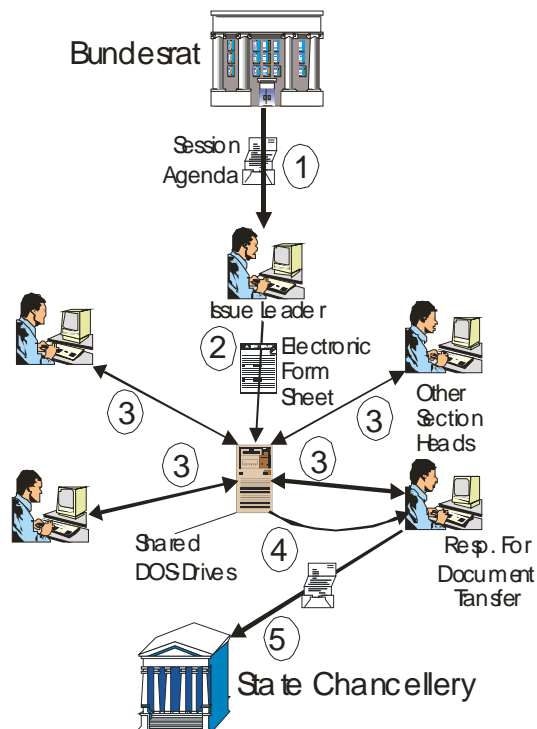


Figure 5: Vote Preparation with the new Groupware

factors seem to be the perfect precondition for introducing groupware without spending resources for analysis of the work practices, for task-oriented training, and for additional support to understand process innovations. We consider these assumptions to be invalid.

When the users started working with the new groupware, they obviously did not compare and analyze the features of the old and the new tool system. They only remembered the work routines they had developed using the old system, and tried to re-implement them. Since they had received only a function-oriented training without referring to their actual tasks, they were not able to adapt their work practice to the specifics of the new groupware. This caused several breakdowns in cooperation.

One example is given above, with the relocation of the electronic form sheets within the "Vote Preparation" process. Having sufficient knowledge of the work processes and the technical system, one could eliminate this problem by introducing a second, issue-leader-related subdirectory structure on the drive "K:". The issue leaders would keep all the form sheets they are responsible for in their subdirectory until they are completed by their colleagues. They would copy them into the appropriate session directory. To provide a session-oriented overview about the issues, dummy form sheets could have been maintained in the session-oriented subdirectory structure.

Another example is the collaboration between one section head and his secretary. In the old groupware they shared a workspace where access was restricted to both of them. These users tried to transfer the concept into the new groupware by sharing a subdirectory on the public drive. However, it was not possible to restrict access rights. Therefore, they used the messaging service of the groupware to transfer documents from one computer to the other. This sometimes caused misunderstandings with regard to the actual state of a document. They could have asked an administrator for a shared network directory, but they were used to being able to create workspaces themselves, and were not aware of the new mode for implementing their requirements. Thus, introducing groupware into organizations has to be seen as a process where technological options and work practice merge.

In this context it is also important to take note of the role of metaphors to make the tool's features understandable to the users. The old groupware system provided special office-related metaphors for container concepts (e.g. "closet", "folder", etc.). However, on an abstract level, both groupware systems offered exactly the same options to for constructing categories for storing documents: individual workspaces ("desk" vs. drive "G:") and group workspaces ("closet" vs. drive. "K:") as well as further means for structuring ("folder" vs. directory). Similarly to the experiences made during the removal phase (see above), most users did not recognize these options within the new application. The metaphors, not the abstract container concepts, had become part of their perception of the

tools. Even after the new concepts had been understood and became part of the everyday work practice, users remembered the metaphor-oriented container concept as being much more convenient.

6 Discussion

The case study presents a long term account of the introduction, use, removal and reintroduction phases of a groupware infrastructure. Covering these different phases, and with them the appropriation and the re-appropriation of a groupware tool, the empirical material is rather unique. In the following we want to make use of the empirical material to evaluate different theoretical approaches dealing with the appropriation of groupware in organizational settings. We will also discuss implication for organization development and groupware design.

6.1 Theories of Appropriation Processes

With regard to the appropriation of technology in organizations, the available literature offers different and partly contradictory conceptualizations which are based on the Structuration Theory. These theories differ in the way they see structure and technological artifacts as being related to each other. While Orlikowski (1992) and DeSanctis and Poole (1994) assume that technical artifacts structure human action, Orlikowski (2000) assumes that only those features of a technical product which are applied in work practice contribute to the structuration of human action.

The Vote Preparation process is a very interesting case with regard to this issue. This process was supported by different technological infrastructures and underwent considerable changes. However, the variations in the technological infrastructures did not lead immediately to a different process pattern. For the first eight months after the introduction of the groupware, the potential of documenting the votes from the different sections at the same time was not perceived and realized. Though the computer network disappeared when the first groupware was removed, the parallelization pattern of the process were kept. The basically unchanged process became more efficient later with the introduction of the new computer network.

Obviously the object sharing feature of the groupware, which enabled the parallelization of the Vote Preparation process, did not become directly part of the SRB's section heads' practice. They either did not know about the options the groupware system offered, or they could not apply it to the vote preparation process. With regard to this process, the existing technology did not have a relevant effect on the section heads' structuration of action. This case strongly supports the conceptualization by Orlikowski (2000).

DeSanctis and Poole (1994) differentiate Orlikowski's early notion of structure being embedded in technology by adding the concept of "spirit". This concept seems to be rather problematic in the light of the empirical data presented. In the case of the Vote Preparation process, the technological infrastructure changed from a groupware application towards stand-alone computers connected via paper printouts or floppy discs. Finally the file sharing feature of the operating system became the technological base for the work process. These technologies differ strongly not only in their features but also in their "spirit", although they were appropriated in a very similar way. So the concept of spirit does not have any additional explanatory value in our case.

Our experiences leave us doubting whether the concept of "spirit" as suggested by DeSanctis and Poole (1990) and DeSanctis and Poole (1994) helps understanding the appropriation of technology. We perceive "spirit" as being a property independent of the player's structuration process. This makes it a very problematic concept. We believe that more than the technological features, the spirit of an application is subject to interpersonal interpretation. Technological features have a double nature (cf. Floyd 2002). Though they are interpreted by the user, they have also an "objectified" substance in the sense that they lead to identifiable transitions within the technical system. The perception of the dynamic system behavior restricts the interpretative leeway of the players. The spirit of an application is not built on such a double nature. It is defined as a property which can be best discovered by the researcher by investigating different materials and attitudes related to the system. It is questionable whether such reconstruction leads to an improved prediction of appropriation processes. We rather believe that an in-depth investigation of the individual users' work practices and technologies in practice may increase the likelihood of predicting appropriation processes.

The long-term case study hints to another important aspect which has not been focused on sufficiently in DeSanctis and Poole's (1994) appropriation model: the dynamics derived from prior experiences with similar technologies. This aspect seemed to have strongly influenced the appropriation of technology during the removal and reintroduction phase. Our findings from the re-introduction phase indicate that increased experience of users in dealing with a certain type of application changes their perception of newly introduced applications of the same type. After the new software was installed, the members of the SRB made up their minds very quickly, stating that the most important features they were used to, are missing of the functionality was missing. This disappointment created a reluctance to appropriate the time management feature. It was generally considered to be useless. However being familiar with their work practice, the authors at that point playing the role of the observers envisioned reasonable ways to apply this functionality. These findings support Mark's et al. (1997) suggestion that users of groupware mature or, in Orlikowski's (2000) terms, enact structure. This process for increasing maturity obviously goes beyond single applications

and modifies the preconditions of further appropriation processes. So the structuration processes emerging from the application of certain technologies can be effective even beyond its physical presence.

Reconsidering Structuration Theory as the basis for the approaches discussed, the most important thing to us to note is Giddens's rejection of the material existence of structure:

"<...> a position I want to avoid, in terms of which structure appears as something 'outside' or 'external' to human action. In my usage, structure is what gives form and shape to social life, but is not itself that form and shape - nor should 'give' be understood in an active sense here, because structure only exists in and through the activities of human agents." (Giddens 1989)

Also inspired by this comment, Orlikowski (2000) complemented her earlier work with a "practice lens", where not technology (and "embodied structure"), but "technology-in-practice" (and "human agency and the enactment of emergent structures in the recurrent use of technologies") is the focus of observation. In this interpretation, Structuration Theory may come - in its application to technological domains - surprisingly close to the Activity Theory (cf. Redmiles 2002),

Aside from the methods rooted in Giddens's (1984) theory of structuration, we assume that Luhman's (1984) theory of self-organizing social systems may also provide a fertile ground for analyzing change processes following the introduction of a groupware (Erikson and Wulf 1999; Paetau 1994). Drawing on Maturana's theory of autopoietic systems, Luhman's (1984) theory is especially adequate for explaining why the introduction of a technical artifact will have unanticipated consequences for a social system. A technical artifact such as a computer or a power station, can never be embedded in a social system. Both systems are completely different. But the introduction of a technical system may disturb or irritate the social system. The social system reacts in a self-organized way to the changes of its environment. In contrast to this, technical artifacts are fixed at the moment of their implementation into an organization. They need an intervention by a human actor, i.e. user, support staff, system's engineer, to adapt them to new situations (cf. Wulf 1999).

In the following we discuss some practical implications of our observations, especially regarding consequences for the design of technology and the related processes. Again we relate to the Structuration Theory in this discussion.

6.2 Perspectives on Organizational Change Management

Orlikowski and Hofmann (1997) suggest a weak categorization of technology-induced organizational changes, which aim at supporting change management. In their "Improvisational Model of Change Management" they differentiate between anticipated, opportunity-based, and emergent changes. These categories can be found in our case study, as well. We saw anticipated changes in the acceleration of document transport and in the task shift concerning text typing. The process

improvement of the Vote Preparation is an example of an opportunity-based change, because it occurred unanticipated, but was planned and introduced purposely afterwards. An emergent change showed up in the appearance of collaborative document production, which was unanticipated and unplanned. The pattern of communication among the section heads also changed in an unanticipated and unplanned manner (cf. Mark and Wulf 1999).

However, our findings also show that Orlikowski and Hofmann's (1997) categorization might not be sufficiently differentiated. The reorganization of typing, which moved tasks from the typists to the section heads, was anticipated and planned. However, the full extent of this task shift could not be anticipated for two reasons. First, it was impossible to estimate how much of the work load would shift from the typists to the section heads. The section heads didn't know how much typing would be acceptable for them beforehand. There are in fact still huge differences with regard to the extent to which individual section heads type their own documents. Second, the extent of the task shift in typing was related to the time the section heads saved due to the innovation of the Vote Preparation process. This innovation was an unanticipated change.

As we see it, the proposed model of organizational change should be extended by the notion of "Change Dependencies" resp. "Change Overlap". As described above, organizational changes can significantly influence each other. To manage change processes it is important to carefully check which dependencies between ongoing change processes arise and what the nature of the dependency is.

The original model clearly relates to Orlikowski' earlier work. Our extension relates to her later interpretation of applying Structuration Theory (cf. Orlikowski 2000). Our work confirms that observing the nature of the emergence of structures (and the related activities) is more important than trying to find out the nature of present structures.

As an additional challenge to change management, business environments request the investment to introduce groupware to be legitimized by measurable economic advantages. We agree with Button and Sharrock (1997) who asked the CSCW community to "...develop measures to the value of proposed systems for organizations and users that trades on the entwined relationship between technology and organization" (p. 14).

Looking at the case study at the end of the usage phase, positive outcomes were found regarding the speed of work processes and the quality of their outcomes. Two patterns led to these changes: the acceleration of document transport and the parallelization of process steps. Especially the Issue Distribution process was sped up by the opportunity to transport documents electronically. The parallelization of the Vote Preparation process also saved two days of work according to a section head. Part of the time saved was used to extend negotiations on some Bundesrat issues. This was considered a quality gain in the outcome of the process.

But the acceleration of the Issue Distribution and Vote Preparation processes and its potential for better decision-making was later not appreciated unanimously. Some actors considered this change to be an unnecessary complication. For instance, a section head doubted the usefulness of allowing all actors involved in the Vote Preparation to access the web server directly (which provided the relevant documents for *all* issues) of the Bundesrat. He expected the decision finding to be more difficult when all ministries had access to all issues. As he saw it the existing time pressure considerably eased the decision making. In addition, an free use of the web server would substantially endanger his and the SRB's position as an "information gateway".

With regard to the productivity gains in the SRB, the picture also remains unclear. On the one hand, document typing was taken over mainly by section heads, which saved labor in the typing pool. On the other hand new computer-related tasks came-up such as user support and system administration.

Both examples show that the result of measuring "success" is dependent on the point in time when the change process is evaluated as well as on the notion of different or incompatible measures. The latter is problematic even for ex-post evaluations, but the case study indicates that it is most difficult to predict the effects of a groupware's introduction ex-ante. Described in Orlikowski and Hofmann's terms (1997), the effects of anticipated changes can only be predicted at the beginning of a project when an investment typically has to be justified. Most of the organizational impact in our case study was created by opportunity-based changes and their interrelation with anticipated ones. Consequently, the effects are hard to perceive, measure, and evaluate.

Judgments regarding the quality of groupware-induced process changes are obviously far from equivocal. Even in cases, where improvements are obvious, these improvements may be judged differently by the different actors (cf. Bowers 1994). This fact supports the argument of Blythin et al. (1997) that success or failure of groupware appropriation in a specific organization is difficult to measure. According to our experiences, such measures will not be valid in a universal sense but strongly biased by those who define them.

6.3 Valuing User Participation

Looking at the rather successful appropriation and the problematic re-introduction phase, the case study indicates a strong need to directly involve all potential users of the groupware. This point is supported by a large body of work in the CSCW literature (cf. Schmidt 1991; Okamura et al. 1994; Bardram 1996; Whitehead 1996; Hepsoe 1997; Mambrey and Robinson 1997). The main issues relating to our experience are:

- First, for choosing and reorganizing the work processes, participation is necessary since only the users master the contingencies of their work. Without a detailed understanding of their informal work practices, we had not been

able to support their work appropriately.

- Second, user participation is needed to configure and further develop the groupwares' features. Although the electronic circulation folders which the groupware offered were judged as "interesting" on the management level, the majority of users never felt a need for them because their work processes had been simple enough to maintain an overview without further electronic support.
- And third, user participation was crucial for sustaining a high level of interest in the ongoing change process. Even after their working hours, staff members of the SRB voluntarily participated in the evaluation of three research prototypes based on LinkWorks and suggested new modes to apply the groupware system (cf. Wulf 1999a). The employees have been prepared and motivated for participation throughout the first workshops and initial platforms, where new ideas had been generated and continuous reflection on the way the organization worked was stimulated.

The strong need to involve the user when introducing a groupware becomes even more evident in the observation of the re-appropriation. The users did not have any influence on the selection of the new groupware product. The IT service providers did not analyze the given work processes. As a result, users only appropriated the functions which helped them to reproduce the work practice they knew from the old groupware environment. In this case, the appropriated functions were also accessible from the operating system, which resulted in the use of operating system interfaces rather than the use of the new groupware. The additional feature of the new application (collaborative time management), though presented to the users in two workshops, and though estimated as being useful by change managers, was not appropriated. The groupware was not used at all because the users felt that their needs were disregarded in the introduction phase, and they developed a negative attitude to the new product.

We interpret the need for user participation in technology development also as being directly derivable from the perspective on social structure and human action developed within Structuration Theory. We cite a summary from Jones (1999, p. 105):

"Giddens emphasizes that social structures do not exist independent of human action, nor are they material entities. He describes them as 'traces in the mind' and argues that they exist only through the action of humans. This leads to a view of human beings as being in a constant state of reflexive monitoring of their situation and to the omnipresent potential for change."

If structure is only visible through action, it is most plausible to increase the visibility of actions the players involved in the development and appropriation of a technology. It is the only way to match and align the different "structures" involved. Traditionally, designers had a 'natural' way of acting through designing, but the acting of users usually is far less stimulated and visible within design processes. Such a theoretic stance can explain why participative approaches offer benefits for analysis as well as appropriation support.

6.4 Valuing an Integrating Perspective on Organization and Technology Change

Our findings confirm the practical importance of considering and stimulating organizational change processes accompanying a groupware's introduction. The introduction of the groupware into the State Government took a "technology first" perspective. The initiative was taken by the middle management in order to learn about groupware technology. The promoters did not consider organizational change.

However, our experience indicates that a "technology first" perspective does not prove to be appropriate. Organization and technology interact with each other, often in a non-anticipated way. Technology-induced task shifts and new emergent collaboration patterns influence work culture and qualification requirements. So organizational structures need to adapt to reflect these changes. On the other hand, organizational changes require modifications of the technical infrastructure and its configuration, as well.

These findings are illustrated by the cases of the invention of the new Vote Preparation process (organization appropriates technology); the redistribution of PCs among section heads following that invention (technology adapts to organization); or the task shifts following easier text production and the need for computer support (organization appropriates technology). Another example for "technology adapts to organization" emerged from the handling of document sharing. Sharing started when the document's owner sent a link to the document to another user and could only be terminated by the recipient. With the invention of the Vote Preparation process, this behavior became unacceptable for the section head responsible for the document transfer to the State Chancellery. The section head was worried that other section heads might change the form sheet document after the set deadline for completion. The program had to be extended to allow document owners to end a document sharing process.

The true nature of intertwined technological and organizational issues can be studied to its full extent when observing the removal of the technology. In our case the inter-organizational communication was narrowed significantly and shifted to older media (fax). The staff members had serious problems with readapting to the old procedures, and several breakdowns had been observed. Especially the remaining typist had to face an unmanageable workload. Organization-internal and -external expectations concerning process speed and quality have risen during groupware usage, but those standards could no longer be matched.

Lacking attention towards organizational and educational problems can lead to severe problems in "technology first" projects (e. g. Rogers 1994). Examples for such problems are the lacking attention to task shifts, e.g. the management's refusal to provide a UNIX course for the local expert, or the events that led to the groupware's removal. Therefore, it is practically important to be equipped with an

appropriate understanding concerning the relationship between organization and technological change. Based on an interactionist's perspective, support for a continuous and integrated development of organization, technology and qualification should be provided. Options for organizational and personal development should be considered from the very beginning of any groupware introduction. On the technical side, the groupware applications should offer the highest degree of technical flexibility possible, e.g. through tailoring functionality.

6.5 Valuing Infrastructure Awareness in the Design of Technologies

By taking the chance to observe the phenomenon of re-appropriation, we widened the traditional one-tool perspective to a perspective of observing continuous technological infrastructure appropriation. In our case, groupware removal and the re-introduction of another product are most important modifications of the infrastructure, which resulted in problematic appropriation processes. Though the removal mainly resulted from management failures, the technological infrastructure was outdated, as well. These adjustments of technological infrastructure are not untypical, the desire for a uniform, organization-wide infrastructure, the need to unite different organizations' infrastructures, or the discontent with a vendor's service or with its product are further reasons to remove a groupware. Another reason stems from organizational development processes. If these processes change the requirements for the technological infrastructure they may not be met by the existing one (cf. Wohland 1994).

Taking an "infrastructure perspective", technological change happens frequently. Our case shows that the designers of the product under our observation were not aware of certain needs an infrastructure may have. Support for de-installation and re-introduction processes are new requirements for groupware products, and substantially increase the flexibility of a technological infrastructure (cf. Wulf 1999). Our experiences let us comment on some aspects in detail:

First of all, the documents stored in the groupware system have to be made available for the users appropriately. Exporting documents from the groupware with its client/server architecture into structures of the underlying operating system can be automated by the groupware as far as possible. This should include document export to all users having read access to a document and automated the copying of the workspace structures to (shared) directory structures.

Additionally, the organizational structures (workflows, roles, workspace structures, etc.) mapped in the groupware system can be exported as texts or graphics for documentation and conservation. However, informal knowledge, like group conventions (document naming, storing strategies) or individual habits, will have to be developed with the introduction of the new groupware platform. Documentation support of given conventions could ease this transition.

Findings from the tailorability discussion indicate that users want new program versions to be equipped with the screen design and menu structures they are already used to (cf. Mackay 1990; Wulf and Golombek 2001). When replacing a given groupware by another one, this requirement is difficult to meet, especially if the applications differ in interface concepts or functions. However, a standardized naming scheme for groupware functions and general rules to structure menus would ease the transition between different applications. Interoperability standards would be helpful, similar to the standards developed by the Workflow Management Coalition⁶ for workflow systems. Since groupware products are more flexible in their different functions, this standard would have to be extensible. Such a standard would ease the transition between different applications.

More general, and more important, a tools' tailorability, and the documentation and negotiation processes related to this property, gain a special value for the application of Structuration Theory on groupware design. Similar to our argumentation for valuing user participation, we again refer to Giddens argument that structures only find manifestation through human action. Tailorability (including the related processes of negotiating and documenting configuration changes) may be an additional way to render users' actions more visible, thus improving a mutual understanding and alignment of structures. Taking such a stance, we move from a call for tailorable systems to the requirement of an integration of appropriation support into the design of technological infrastructures.

Obviously, a system design which would take into account the dynamics of a tool being part of an infrastructure as we demand it, would violate the interests of software producers who aim at binding customers by means of proprietary technologies.

7 Conclusion

Describing and discussing experiences from a longitudinal field study, we traced the question how the relationship between organizational change and technology introduction can be theoretically understood and which practical conclusions for the introduction process emerge from such an understanding. We focused our discussion on approaches in the tradition of Giddens' Structuration Theory.

Our field study offered us the opportunity to observe not only the appropriation of a groupware, but also the *re-appropriation* of an other groupware. We coined this term "re-appropriation" to label the consecutive appropriation of a technology which supports similar tasks and which has features similar to but still different

⁶ The Workflow Management Coalition is an organization in which the main producers of workflow management systems develop standards to exchange workflows across individual products.

from the one used before. Our results confirm the pleading to shift perspective from the observation of organizational change related to the introduction of a single application towards a focus on the appropriation of a whole infrastructure. An Infrastructure undergoes permanent changes and thus continuous processes of appropriation.

We focus on describing the evolution of a specific work process during the different phases of groupware (re)appropriation. Interesting observations included:

- the persistence of cooperation patterns even when the technology which had enabled them was taken away,
- the different judgments on the success of the appropriation in relation to the point in time of the judgment and the individuals' interests,
- the discovery of the interdependencies between different events in organizational change, and
- the lack of an awareness of technologies of being part of an infrastructure, and of the eventuality in being removed.

Our observations showed that organizational changes induced by technical innovations may take their time, that their outcome is not easily predictable, that it is interpreted in different ways by different people, and that effects occur on multiple levels (individual workplace, work distribution, social level). We concluded that for initiating, planning and coping with organizational change processes, it is important to note that the effects of different organizational and technical innovations can influence each other significantly. Models of organizational change processes should reflect these aspects, which we discussed along Orlikowski's "Improvisational Model of Change Management".

In our theoretical discussion, we related our observations to three approaches of capturing the interdependencies between organizational and technological change. All approaches root from the Structuration Theory. We criticized two of them (Orlikowski 1992, De Sanctis and Poole 1994) regarding their tendency of assuming structure as being embedded in technology, and gave examples from our field study, which questioned this assumption. In that respect, we were able to confirm the findings in Orlikowski (2000), where she proposes a shift of focus from the goal of understanding the nature of structure, to understanding the emergence of structure as it is manifested in human actions.

Based on our observations and our theoretical reflection, we generated practical recommendations on how to support appropriation processes, and how to improve the design of technologies to appropriate. The main goal of better appropriation support and the improvement of tool design is the support of the visible acting of all participants in the process of technology production and appropriation.

Although we focused our contribution on evaluating Structuration Theory in the domain of groupware appropriation, we also documented many interesting

phenomena accompanying organizational and technological change during a five years' period of time. These empirical findings could also be interpreted in the light of other theories (e.g. Activity Theory, Luhmann's Theory of Self-Organizing Systems). The question which theory is best applicable for informing IT design and related processes, strongly relates to the ways we, as IT researchers, are able to appropriate the artifacts designed for us by social scientists. With the words of Tom Erickson (cited from Nardi 2002):

Neither holy grail, nor deep disgrace,
theory's useful in its place,
(Framing, talking, predicting, bonding,
evoking discourse--Others responding)
Like goals and methods, plans and actions,
theory's situated, not pure abstraction.
So make your theory a public way,
where passers by may pause and stay.

8 Acknowledgements

We would like to thank our colleagues Torsten Engelskirchen, Helge Kahler, Markus Won, Andrea Bernards, Gunder-Lily Sievert and Sarah Kemp for their work in the application field and their comments on earlier versions of the paper. The remarks of three anonymous reviewers have challenged our ideas and helped elaborating our argumentation. The POLITeam project was supported by the German Ministry for Education and Research (Research Grant Nr. 01 IT 402B/2).

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