

Evolving Cooperation when Introducing Groupware: A Self-Organization Perspective

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Abstract: The introduction of groupware into organizations impacts the existing patterns of cooperation. Applying the theory of self-organizing social systems, we try to gain insights into these introduction processes. We look at Maturana's theory of autopoietic systems and show how Luhmann has drawn on it for the analysis of social systems. In the following, we present case studies of evolving cooperation when introducing groupware into two organizations of the political administration. Using the theory of self-organizing social systems, we analyze these case studies. It turns out that evolution, technical flexibility, and participation are important factors when introducing groupware into organizations.

1. Introduction

In many scientific disciplines the paradigm of self-organization has received increased attention during the last decades. Though these approaches deal with different phenomena, they have one point in common: they all overcome the traditional mechanistic interpretation of reality. In this paper we will discuss the paradigm shift in organization and management sciences. Due to a changed macro-economic environment of relatively saturated markets, organizations have to react more flexibly to demands of their clients. Under these conditions the dominant mechanistic paradigms for prescribing and describing organizational reality are replaced by approaches which take self-organized behavior into account.

Looking at the prescriptive approach in management science, the tayloristic paradigm perceives organizations as social units, which can be controlled mechanically from the top (cf. Taylor, 1919). In the descriptive approach of contingency theory, scholars searched for factors in the environment of an organization which were supposed to determine the structure and performance of an organization (cf. Lawrence and Lorsch, 1967). Contrary to these approaches the paradigm of self-organization assumes that organizational behavior cannot be determined from the outside. Attempts to control a system's behavior have to be

perceived as perturbations to which the organization as a social system reacts in a non-predictable way.

Empirical evidence for self-organized behavior can be even found in organizations which seem to be still structured according to tayloristic principles. This fact can be exemplified by looking at the treatment of prescriptive rules, which are supposed to coordinate collaborative work. Mambrey and Robinson (1997) report about cases of self-organized work practice in a strictly structured federal ministry which violate predefined rules. Evaluating a workflow system whose process model formalized an organization's rules to purchase equipment in a rigid way, Kreifelts et al. (1991, pp. 127) found out that the users felt "fenced in" because they could not ask other members of the organization for informal advice, in case it was not foreseen in the formal procedure. This was one of the reasons, why the workflow system failed in this field of application. These examples illustrate that even in tayloristic organizations, cooperative work practice can be hardly described by rigid rules imposed on the organization members.

Taking a prescriptive perspective, which is immanent in management sciences, such observations have led to the development of new organizational concepts. Although concepts like "lean production" (Womack et al., 1990), "virtual organization" (Davidow and Malone, 1993), "semi autonomous workgroups" (Brödner, 1993), and "fractal factory" (Warnecke, 1993) differ considerably in their point of emphasis, they are based on similar principles. Following Kieser and Kubicek's (1983) categorization to describe organizational structures, the difference between self-organization related and tayloristic concepts can be clarified by looking at the division of labor and the mechanisms for coordination. When organizations divide the labor between their subunits, a specialization according to functions can be distinguished from one according to objects¹ (cf. Kieser and Kubicek, 1983). Contrary to tayloristic concepts, which are based on a division of labor according to functions, concepts based on self-organization suggest to use a division of labor according to objects. Dividing labor within an organization requires mechanisms to adjust the different subunits. Concerning mechanisms for coordination, Kieser and Kubicek (1983) distinguish four different types:

- coordination by planning,
- coordination by programs,
- coordination by hierarchical decision making,

¹ Objects represent the output of an organization with regard to the customers' or markets' needs. Products, services or bigger parts of them are fully produced in one organizational unit in case the labor is divided according to objects.

- self-coordination by non-hierarchical communication.

Coordination by programs is based on the application of generalized rules, which secure the adjustment between single subunits. Coordination by planning requires a scheduling of precise goals for subunits in advance with the help of routine or algorithms. Both of these mechanisms are applied to coordinate subunits prospectively. The mechanism of self-coordination and hierarchical decision-making allow ad-hoc coordination. In the case of hierarchical decision making organizational subunits are coordinated by instructions given from a higher level of hierarchy. In the other case they are coordinated by bargaining processes among hierarchically equals. Contrary to tayloristic approaches which were based on prospective coordination and coordination by hierarchical decision making, prescriptive approaches following the paradigm of self-organization stress coordination by non-hierarchical communication.

To overcome tayloristic structures and to allow for self-organized behavior, processes of organizational development have to be initiated. Furthermore, even if tayloristic structures will be overcome, existing structures will have to be permanently questioned to adapt an organization to changing market-requirements. Thus, organization development has to become a permanent activity.

As groupware are computer applications which are explicitly designed to support communication and cooperation, their introduction plays a role in this ongoing process of organizational change (cf. Ciborra 1996; Orlikowski and Hofman 1997; Pipek and Wulf 1999). So it is important to better understand these introduction processes. Applying self-organization theory, we will examine whether this theoretical position provides a sound perspective to look at these micro level change processes. Therefore, in this paper, we will analyze two case studies of organization change following the introduction of the same groupware application by means of self-organization theory. Such a theory based investigation may allow us to generalize our findings to other change processes related to the introduction of groupware applications. As the technical artifacts – the groupware applications – play a major role in these processes, special attention will be paid to design requirements resulting from the analysis of these case studies. While these considerations mainly focus on the introduction process, we will look at the output of the change processes, as well. From a self-organizational perspective, we are especially interested whether the resulting structures have improved the organization's ability to adapt to changes in their environment.

The paper is organized as follows. In chapter 2 we present self-organization of social systems as the theoretical framework of our analysis. Chapter 3 reports about two case studies of evolving cooperation derived from the POLITeam

project. In the fourth chapter these case studies will be compared to related findings in the CSCW literature and discussed by applying self-organization theory. We will conclude by reflecting on the insights gained.

2. A theoretical framework of self-organizing social systems

Our comprehension of social systems has its roots in the “second order cybernetics” (Foerster 1984) and the theory of “autopoietic systems” (cf. Maturana and Varela 1980). The term “autopoiesis” is defined by the biologist Humberto Maturana for the description of living systems. Luhmann (1984) has drawn on Maturana’s concepts to develop a theory of social systems. In the following we will first present Maturana’s concepts for the description of living systems and then discuss Luhmann’s contribution.

According to Maturana, a system is called autopoietic, if it is able to reproduce itself by interaction of the internal elements of the system. Upon self-reproducing, the structure of the system can change, but the organizational principles remain invariant. Autopoietic systems are independent in the sense that they are not determined by the system environment. Of course, they are related to the environment, but their operations are totally closed. There is not any deterministic input-output-relationship between the system and its environment. Thus, there is not any possibility to control an autopoietic system completely from the outside. Every control has to be self-control of the system. By contrary, technical artifacts are not autopoietic systems. They do not have the ability for self-organization, self-production and self-reference. Maturana and Varela call these systems allopoeitic (Maturana and Varela 1980, Maturana and Varela 1987).

Maturana and Varela (1987) break with the leading distinction between the part and the whole and replace it by the distinction between system and environment.² By using the paradigm of the system/environment difference, emergent systems can be described as permanent repetition of this distinction on various levels. Complex systems not only exist as a network of elements and their relations but as a number of system/environment relationships which are reproducing as a lot of interfaces and therewith the whole.

The kind of modus is the differentiating factor between systems. The similarity of the operations is a precondition to constitute the identity of the system. The autopoiesis will be realized, if the system can use its specific operations to reproduce this identity permanently. The operations need a connectivity³ in the

² Luhmann called that “the central paradigm of the new system theory” (Luhmann 1984, p. 242).

³ Luhmann uses the term “Anschlussfähigkeit” for the permanent connection of system-internal operations, like communication. Maturana defined it as “self-reproducing by the interaction of internal elements of a system.”

context of internal, complex and heterarchical, modular structures of information processing.

Thus, systems can operate only within their own borders. Maturana and Varela (1987) call this property of systems operational closure. They have no possibility to determine other systems. For instance, a consciousness system cannot determine a biological system, because it cannot use biological operations. The only way to influence the system is to disturb it.⁴ All operations are self-referential, i.e. they are oriented to their own (and only to their own) systems state, their structural conditions and their own relevance criteria.

With operational closure, Maturana and Varela (1987) do not mean isolation from the environment. A continuity of energy flow is presumed. The modus of operation in which the interpenetration of the different systems happens is of main significance. In traditional cybernetics, such relations were understood as input/output connections. In system-theory, based on second order cybernetics, they are defined as autonomous self-regulating processes. Input from the environment can lead to reactions but it does not determine reactions. In which way the system reacts depends on the attributes, the state, the actual structure and the internal references of the system. The system defines what it perceives in a specific situation as input and what it does not perceive as input. Thus the system constructs its own reaction to the environment. This reaction is created by means of its operational mode.

Maturana and Varela (1987) use the term autopoiesis for the description of living systems. Nevertheless we believe that there is not any reason to restrict it to living systems (cf. Luhmann 1995). They are autopoietic systems, nevertheless autopoietic systems are not always living systems. Autopoiesis does not refer to specific attributes or substances of the living, rather it deals with the main principles of the organization of living systems. These main principles are primarily the operational closure (instead of the openness of input/output-systems) and the leading difference of system and environment (instead of and the difference of the elements and the whole). In so far the transfer of the term autopoiesis into social sciences in my opinion must not necessary lead to biologization of the social.

In that sense Niklas Luhmann has - heedless of Maturana's reservations - transferred the term of autopoiesis to social systems (Luhmann 1984), a development that has fallen on fertile ground in the organizational sciences. Following the observation, that the selfreferential-closed modus of operations can be observed not only regarding living systems but also regarding social systems,

⁴ Maturana is using the term *perturbation*, Luhmann speaks of *irritation*.

Luhmann has generalized the term of autopoiesis. The autopoiesis is common to both, but a closer look shows some important differences between the operations of living and social systems. Social systems differ from organic and neurophysiological systems (cells, nervous systems) in the way that they orientate their operations to the social constitution of sense. They have no other possibility to constitute sense than by using their own system-specific operation modus: communication.⁵

The use of the term social system includes two theoretical commitments: first, with the term *system* we emphasize a special view on the social. We are not looking for the attributes of the entities or the substance of social phenomena, but our interest is focused on the mechanisms, in which social systems can maintain their identity. Second, the term social system does not characterize a particular quality of the social, but it defines the social as a system, which gets its identity by a distinction from other systems based only on its own operation modus, which is communication. There are other systems, which operate in another way: e.g. conscious systems operate by thinking, living systems (e.g. the immune system or the neuro-physical system) by chemical and electrical reactions. But a system, which is formed by communication, is called a social system.

Following the theory of autopoiesis, one can define a social system neither by formal rules or rigidly structured workflows nor as a means to an end. In this understanding a social system is the whole communication context. The consequence of this consideration is that a technical system (e.g. a computer or a power station) can never be embedded in a social system. Both systems are completely different. A social system operates self-referential. Therefore, it can - like a living system - react fast and in a self-organized way to the impulses of the environment. Technical systems are allopoietic systems (cf. Winograd and Flores 1986). After the moment of their implementation into an organization, they are fixed. To adapt them to new situations, they need an intervention by a human actor (user, support staff, system's engineer).

3. Case Studies on Emergent Organizational Change

In the following we will apply the theoretical concept of autopoiesis to analyze processes of organizational change in the context of the introduction of a groupware.

⁵ It is important to notice that the entities of a social system are not individuals, but it is communication. Individuals are parts of the environment of a social system. They can influence the system from the outside.

We present two case studies from the POLITeam project. In the respective project the organizations did not intend to change their work processes related to the introduction of the groupware. The organizations participated in an evolutionary software development project of a groupware application, which was intended to support locally distributed work. Thus, they were mainly interested in receiving an appropriate groupware solution as a result of the project. To catch the organizations' requirements, a configured version of DEC's LinkWorks system, so called POLITeam I, was introduced for everyday use. The users were supported regularly by certain project members - called user advocates. Furthermore, workshops were held, in which users, user advocates and designers participated. Based on these experiences, new system versions extending POLITeam I were implemented. POLITeam I contained mainly the following functions: document sharing, electronic circulation folder, e-mail, and a rudimentary event service (cf. Klöckner et al., 1995; Cremers et al., 1998).

Due to the emphasis on software development, neither the project members nor the applying organizations focused on organizational change when introducing POLITeam I. Nevertheless, two years after the beginning of the project considerable changes in the cooperative work practice could already be observed. In the following we will focus on two of the applying organizations and describe for each of these organizations the most remarkable change processes.

These change processes are described from the perspective of a project member who participated himself in the workshops and performed interviews with the project's user advocates on these topics. So the results are from a collection of materials: workshops, site visits, design-team-user discussions and user interviews. Initial semi-structured interviews were conducted before the system was introduced in order to learn about the potential users' work practice. Further interviews with selected users and user advocates were conducted to clarify the changes in cooperation. The user advocates documented problems and solutions resulting from their regular visits within the different fields of application. Transcripts were also used to record the discussions within the different workshops.

3.1 Preparing a State's Vote

The first field of application was the representative body of a northern German state at the seat of the federal government in Bonn. In this body about 30 people worked to represent the interests of their state within the process of federal legislation and towards the federal government (cf. Pipek and Wulf 1999). Before introducing POLITeam, there were only few stand-alone computers in the

representative body - mainly for word processing. Most of the workers did not use a computer. When introducing the POLITeam I version of the system, 10 employees got equipped with the system. As it was originally thought to support vertical cooperation within the representative body, the systems were distributed among staff personnel, managers of certain sections and to the secretary of the head of the body. In the course of the project a rather different work process turned out to be improved by the introduction of groupware.

One important task of this body is the preparation of the decision making within the Bundesrat, which is the second chamber of the German parliament representing the state governments. The Bundesrat meets once every third week to discuss and to vote each time on about 80 different issues. The representative body has to prepare the state's voting on each of these issues. Therefore, the organization structure of the body mainly consists of sections representing state ministries. Each section is headed by a section manager. Most of them consist just of the manager. Each section has to express the attitude of the represented ministry if this one is affected by one of the issues to be discussed in the next session of the Bundesrat. For each of the issues on the agenda, one of the section managers is responsible to prepare the state's vote. The preparation of decision making takes place under time pressure. It starts as soon as the agenda of the next meeting of the Bundesrat is set. It has to be finished well in advance of the meeting, because the recommended state's vote has to be finally agreed upon by the office of the state governor, which is situated in the state's capital.

As a means to document the process of decision making within the representative body, the responsible section manager used a form sheet for each issue. He marked the issue and fills in a voting proposal of his section after consulting the ministry represented by him. Furthermore, he wrote down the name of other sections of the body, which have to get involved in the decision-making. Before the organizational innovation took place, the form sheet was printed on paper and the responsible section head carried it to the colleagues being involved, as well. If they were in their offices their voting proposal could have eventually been marked directly as the form sheet was deposited on their desk. After one section had finished its job, the sheet was brought back to the main responsible, who distributed it to the next section involved. Finally, all the form sheets were given to one section manager who was responsible to discuss the outcome with the office of the state governor. Due to the fact that section heads were often out of the office, it was rather troublesome for the responsables to get the form sheets ready.

This mode of cooperation prevailed quite some time after the POLITeam system was introduced. Neither the project members, who had conducted interviews with the users before introducing the system, nor the users themselves, being

taught about the functionality of the application, directly recognized the potential for process innovation. Several weeks after the system's introduction, a project member being responsible for user support in the representative body got curious about the many form sheets lying on the desk of one of the section managers. He asked about the purpose of these forms and realized that the object-sharing feature of the POLITeam application could be used to ease the voting process. He involved other section managers and the local system support to work out an electronically supported procedure.

This procedure works as follows: The form sheet used for this process is stored in a public folder. Each section manager can copy it from there and fill in an issue of the agenda. Furthermore, he can input the vote of his section. He can now send a link to the document via e-mail to all the other section managers being involved in the issue at the same time. The reception will be indicated in their electronic mailbox and they can input the vote of their section whenever they like. Because of the document-sharing it is not necessary to maintain a temporal order, except that it is not possible for two users to have access to the same document at exactly the same time. When all sections which had to contribute to an issue have filled in their votes, the manager responsible for this issue sends a link via e-mail to the one who has to harmonize the outcome with the governor's office. Thus, the coordinator finally has access to all electronic form sheets relevant to the next meeting of the Bundesrat. Of course, sometimes section managers are late in either inputting their votes or in making their form sheet available to the coordinator. In this case e-mail or telephone is used, or the responsible managers personally go into the offices of their colleagues to remind them.

This innovation, following the introduction of the POLITeam system, eased the coordination by non-hierarchical communication among the section managers. The sequential order to fill in votes which was immanent in the paper-based procedure could be overcome by document sharing in the electronic mode. Thus, all the section managers participating in the voting process got longer time to make their decision. To reach this effect we had to redistribute some of the computer-equipped workplaces because all of the section managers should have access to the system. While this problem was easy to perceive and rather easy to solve, the implementation of this innovation led to two severe problems which had not been anticipated, neither by the members of the POLITeam project, nor by the users at the moment of its implementation. The first problem was caused by a lack of the system's technical flexibility, furthermore, the patterns of personal communication changed after applying the new mode of coordination.

During a routine support visit of a POLITeam project member, it turned out that the design of the document-sharing feature was not fully appropriate to support the voting procedure. The section manager responsible for the final

harmonization of the state's vote with the governor's office had found out that after he receives the form sheet, all the other managers involved in that issue were still able to manipulate their own and even other colleagues' voting decisions. The section manager feared that decisions could be modified hiddenly. This option is caused by the fact that the sharing function was designed in a way, that it only allows the recipient of the access right to finish document-sharing while the sender cannot terminate the recipient's access. The sharing function did not include any options for tailoring in use. As the implementation of the sharing function was rather complex, we could not solve the problem immediately but had to record it as a design requirement for the next version of the POLITeam system.

The second non-anticipated effect of this innovation was a reduction of the personal communication among the section managers. This problem was pointed out by the section manager who receives all the form sheets in the end. He pointed out that before introducing the electronic procedures, all his colleagues dropped in his office to ask for his vote on specific issues and to deliver their form sheets. He had to go into the offices of others to ask for their votes. These visits were occasions to start talking about the issues on voting as well as about other topics and even private matters. Describing himself as a rather shy person, he avoids walking into other people's office without a reason. Thus, he is now missing occasions to talk with his colleagues.⁶ Discussing this problem at a round-table, one of the colleagues who acts as local system support, pointed out that he has a similar feeling. Nevertheless, in his opinion there are now other occasions to talk to colleagues. It occurs whenever a system feature has to be explained or a handling problem has to be solved. Thus, giving system support to him seems a way to compensate the changes in personal communication.

3.2 Cooperative Word Processing

The second field of application was a section of a federal ministry. The section consisted of about five employees and one section manager who all got equipped with the POLITeam I version. This section is supported by typists who belong to the central typing pool. The typing pool's offices are located in another part of the building. Before introducing the POLITeam system, the typing pool was equipped with networked PCs, using a common server to store the text documents. The employees of the section were not equipped with computers for their daily work. As a result of the introduction of POLITeam the cooperation between the typists and the employees of the section changed considerably.

⁶ In other fields of application of the POLITeam project, we found evidence for changing interpersonal communication, as well (cf. Mark and Wulf 1999).

One of the main tasks of the ministry's section observed, consisted in the development of concepts for a certain field of politics. Some of these concepts were developed just within the section. Others were worked out in cooperation with other sections of the ministry. These concepts (e.g. manuscripts of speeches of the federal minister, answers to inquiries from the parliament, or answers of letters sent by citizens) were documented on paper and provided by means of circulation folders for the upper level of the ministry's hierarchy. All the paper documents, for internal as well as for external use, were typed. Before the introduction of POLITeam all typing for the whole ministry was done in the central typing pool. Therefore, members of the section sent hand-written texts or tapes with voice recording to the typing pool. After typing, the texts were sent back to the sender who checked the document. If a mistake was found, it was sent back to the typist who did the correction. This version of the document was finally given to the section manager who was responsible to process it and who might ask for further modifications. As the transportation of the material between the employees of the section and the typists was normally done by internal messengers and as the typists had to schedule their different tasks, it normally took three to four days for the typing of the first version of a document. So if a task was very urgent, the section members used to bring their manuscripts to the typists personally and asked for a preferential treatment. But even this procedure took time, especially if the typed version contained mistakes.

Therefore, after the introduction of the POLITeam system the mode to produce typed documents was changed. The potential of this process innovation has been already recognized before the introduction of the first system version as a result of the proceeding interviews with the future users. In a workshop in which the original system version was presented to the users, the project members presented a scenario, which used the document sharing feature of the system to allow members of the section to correct small mistakes in an already typed document. This idea was appreciated by the members of the section participating in the workshop.

When the system was introduced in the ministry, it was decided to create a shared folder, which should be jointly used by the section and the typing pool. This folder should contain all documents, which are produced by the typing pool for the members of this section. Within the folder were subfolders to store documents produced for each member of the section. The introduction of folders shared between the section and the typing pool allowed new modes for the division of labor. Being equipped with a word processing tool and having the chance to gain access to typed documents, the members of the section could decide flexibly what to type themselves and when to ask the typing pool.

A typical example on how they used this flexibility, is the way one of the members of the section answered an inquiry by the parliament. After this task had been assigned to her, she had to decide which other sections of the ministry had to get involved in the answering. These sections had to get a short letter, informing them about the inquiry and asking the questions to be answered. After answering, their contributions had to be put together with the own ideas of the section member to create a first version of the ministry's answer to that inquiry. This version was given to the hierarchy of the ministry. The whole subprocess within the section happened under extreme time pressure, because the ministry as a whole had just a very limited amount of time to answer an inquiry of the parliament.

Before the introduction of POLITeam system, the member of the section asked the typing pool to write letters to the other sections involved. After receiving the answers, she modified the texts supplied by the other section on the paper and gave it together with her own manuscript to the typists. Before the process innovations she had to wait for the last input to initiate typing. After the innovation she was typing the short letters to the other sections herself. While waiting, she developed her own concept and got it typed already. When the answers of the other sections arrived, she reworked her text herself. Only in case the text was rather long she gave it to the typists. By this new division of labor, she lost less time for the typing procedure. For this increase in response time she was ready to do some extra type-work.

Nevertheless, the introduction of this new division of labor between section and typing pool created some problems. Concerning technical features, it turned out that the event service of the POLITeam I system version was not sufficient to support efficient cooperation. In a workshop to discuss problems of use among users, designers, and user advocates, the members of the section asked for technical functions which made certain actions of the typists visible to them. They wanted to see at the color of an icon, whether the typists have finished working on the corresponding document. Besides, in their folder, they wanted to recognize newly created files by an icon of different color. As POLITeam did not offer these options, we discussed different intermediate solutions. First of all, it was suggested that the typists should send a mail whenever they finished working on a document. The typists found it too labor-intensive and the members of the section feared the flood of incoming mails. As an intermediate solution, the users agreed to use the rudiment features of the already existing event service.

The development of appropriate naming and storing schemes for the typed documents became another problem in the cooperation between the section and the typing pool (cf. Wulf 1997). Before the introduction of the POLITeam

system, the typing pool was the only organizational unit, which stored documents electronically. The central typing pool had created directories for each section of the ministry, containing subfolder for each member of the sections. Within these subfolders all the documents which any typist had written for a certain client were stored. On the third level of the folder-hierarchy, they distinguished five different types of documents to be stored in the same subfolder. Thus, if a client would ask for corrections on a certain type of document, any typist knew in which subfolder to search. To ease finding within the subfolders, all typists used a common convention for the naming of documents. Using the DOS operation system, they were restricted to the use of 8 symbols to name documents. The first 5 symbols of the documents' name were used to indicate the date of a document's first creation, expressing day, month and year in reverse order. Thus, it was possible to search within the subfolders using a temporal structure. This naming and storing system was convenient for the search needs of the typing pool.

When POLITeam I was introduced, the folder shared between section and typing pool contained just one more level of folders containing the documents for each member of the section. To maintain their search pattern, the typists changed their naming convention by starting the name of each document with a letter indicating the document type and continuing with numbers, indicating the date of a document's creation.

During a workshop on problems of use, half a year after the introduction of POLITeam, the members of the section expressed their discontent concerning these patterns of naming and storing. When searching for documents they have not thought of document types, but of their tasks. Working on a task often means to create various documents of a different type. Thus, the mode of storing and naming did not reflect their needs. Discussing this topic, a conflict of interest between the section and the typing pool became manifest. In this situation the members of the POLITeam project proposed different solutions. First, one member of the POLITeam project suggested to keep the naming and storing system like it was, but to tell the members of the section to display the documents in the temporal order of their creation. We assumed that such a display would come close to a task-oriented structure of storage, because documents concerning the same task would be created around the same time. This proposal was perceived positively within the workshop but it was not possible to implement because POLITeam I just allowed to display documents according to the time of their last modification. The members of the section felt that such a display would not be sufficiently task-oriented. Therefore, this compromise was not possible due to a lack of flexibility of the interface display function.

The solution finally agreed on in the workshop, was to introduce a third level in the folder-hierarchy, which would allow to store documents according to the section member's task they belonged to. The naming of the documents was kept like it was, because the head of the computer science department of the ministry had pointed out in the workshop, that it would be necessary to wait for an organization-wide naming convention. Nevertheless, it turned out that the compromise found in the workshop was not put into practice. Half a year later some members of the section still worked with a two level folder-hierarchy. Nevertheless, they complained that the amount of documents within these folders made it very troublesome to find any document.⁷

The fact that the compromise was not put into practice by the members of the section can be seen as a conservation of traditional work practice. Within this ministry, paper documents were stored by registrars - a special stuff section for the whole organization. So storing was not part of the job of the operating sections. They just gave the paper documents away. Obviously individual members of the section did not develop concepts for storing. Still, they complained about the fact that the overflow of documents disturbed their work performance. The storing and naming problems showed that the initial change in the division of labor between the section and the typing pool made it necessary to rethink the patterns, documents were stored and thus, questions the division of labor among the operating sections and the responsible stuff section. It would have required organization development on an organization-wide scale to tackle these problems.

By contrary, another problem in the cooperation of the section and the typing pool could be solved on the spot. In the same workshop, members of the section complained about the fact that typists moved documents out of the shared folder into their private workspace to input modifications. If the members of the section tried to search for these documents, they could not find them. The typists worked in that way, because they were used to work on newly created documents in their private workspace. They did not know about the problems of the section. Perceiving the problem, they agreed on leaving the documents in the shared folder.

Another consequence which is not yet perceived as a problem by the people affected, is the emergent reduction of work for the typists. As the members of the section took over most of the corrections and parts of the typing, the workload in the typing pool was diminished. During the first two years of the POLITeam project this reduction of the workload was rather welcomed instead of seeing it as a problem because just one section within the whole ministry was

⁷ Indeed the establishment of appropriate storing conventions remained an ongoing problem (cf. Wulf 1997).

working in the new mode. Nevertheless, the role of the central typing pool will be questioned when the new workpractice will spread out to more sections.

4. Discussion

In the following, the case studies presented in the previous chapter will be discussed, applying self-organization of social systems as a theoretical framework. We will focus on two main topics related to the introduction of groupware, the process of organizational change and the outcome of this process of change. Concerning the first topic, we will ask whether the self-organization theory is a useful means to interpret these change processes. Moreover, we will discuss what can be learnt from these case studies for other processes of organizational development related to the introduction of groupware. Concerning the outcome of these change processes, we have to ask, whether the resulting structures have improved the organization subunits' ability for self-organized behavior.

4.1 The Process of Organizational Change

Analyzing the process of organizational change three aspects turned out to be of special importance: evolution of the change process, flexibility of the technical artifacts and participation of the members of the organization. In the following, we will look at these aspects more in detail.

Evolution

Looking at the process of organizational change from the perspective of project members who play the role of outside-consultants, certain patterns of the system's usage could not be anticipated at the moment of its introduction. Though we had carried out extensive interviews with almost all potential users, we did not realize all options for the system's usage within the fields of application. The delayed invention of the modified voting mechanism within the state's representative body is a good example for this fact. Even after a careful preparation of a groupware's introduction, organizations have to be perceived as social systems, which are operationally closed towards outside-consultants. So the exact way in which an organization makes sense of a groupware application cannot be anticipated from the outside. The activity of the user advocate who started the discussion on the electronic form sheet can be seen as a perturbation of the social system, which finally led to a new mode of cooperation. Thus,

activities of outsiders can influence organizational change, but in a nondeterministic way.

Orlikowski's case study (1995) supports these findings. She describes the changes in the cooperation within a software company's customer support unit following the introduction of Lotus Notes. To analyze organizational changes, she distinguishes between planned and emergent changes. Planned changes are those which have been intended by the management at the moment of the introduction of the groupware or a new version of it. By contrary, emergent changes were not anticipated at these moments but happened opportunistically during the application's use. They occurred either because the users suddenly recognized the potential of certain features of an application to improve their cooperative work or because non-planned effects of earlier changes had to be compensated. In Orlikowski's study an important part of all organizational changes came along as users suddenly recognized new modes to apply the system. Thus, in this case the self-organization of an operationally closed social system played a major role in applying the groupware. The organizational subunits can be seen as operationally closed even towards changes which were not anticipated by the management.

In our case the lacking ability to foresee certain patterns of a system's usage cannot fully be explained by missing plans for organizational change. As shown in a case study by Orlikowski (1995), emergent changes occur even if the management of an organizational unit plans changes related to the introduction of groupware.

More difficult even than the actual usage of an application, one can anticipate the consequences resulting from it. This general problem seems to be of special importance, if organizations follow tayloristic principles and divide the labor among their subunits according to functions. Though changes in the work-practice of one unit often have direct consequences for other units, in these organizations there exists typically little knowledge on the work-practice outside the own unit. The members of one subunit generally have problems to imagine the consequences imposed on other subunits. Thus, we have to understand these subunits as individual social systems. Often, unpredicted consequences get visible after the patterns of cooperation have changed already for quite some time. For instance, when we introduced the shared folder between the typing pool and the operative section, nobody anticipated the resulting conflicts in naming and storing the documents. Even after one year and several attempts to find a consensual solution, this problem remained. The change in personal communication noticed in the state representative body became obvious well after the organizational innovation was put into practice.

Unpredicted consequences resulting from planned and emergent changes have been found in these case studies as well as in the reports by Orlikowski (1995) and Rodgers (1994).⁸ These findings can be interpreted with the concept of operative closure. The introduction of groupware and efforts to create change are in this perspective just disturbances irritating the subunit affected. Even if they lead to some kind of organizational change, the consequences of these changes cannot be fully predicted from the outside. This is due to the fact that every social system constructs its own reaction to disturbances from the outside. As different social systems react to perturbations in a self-organized manner, the consequences on common work processes are hard to anticipate. Organizations being structured according to tayloristic principles are obviously more vulnerable to this fact, because a higher number of independent social systems have to interact within single business processes.

To use the potential of emergent changes and to handle unpredicted consequences, organizational change related to the introduction of groupware has to be seen as an evolutionary process. Orlikowski (1995) comes to a similar conclusion as a result of her case study.

Technical Flexibility

Being allopoietical systems, groupware applications should be designed in a technically flexible way to allow for emergent organizational change. A groupware is flexible in a technical sense, if the implemented functionality either can support different patterns of cooperation, or the functionality can be adapted fast enough for the not anticipated organizational changes. To minimize efforts necessary to adapt groupware Wulf and Rohde (1995) suggest to combine approaches of tailoring in use (e.g. Henderson and Kyng, 1991) with evolutionary approaches in software engineering (e.g. Floyd et al., 1989). If the actual functionality does not support new modes of cooperation, first of all, existing options to tailor the groupware should be applied to satisfy the organization's need. Only in case tailoring in use is not possible, a new system version has to be developed. Finally, technical flexibility can be reached by abandoning the use of an existing system and its replacement by a new application (cf. Wulf, 1996).

⁸ Rodgers (1994) reports on emergent organizational changes which are caused by non-planned effects of the introduction of a networked application. The management of a travel agency decided to replace an existing application by a new one because the selected product offered features which eased their work. Nevertheless, the new system contained functions whose rigidity enforced a modified division of labor between different organizational subunits. The additional workload allocated in one of the subunits created major problems.

Within processes of emergent organizational change, the functional requirements are not fully defined at the time a system is introduced. Thus, the system's architecture and the options for tailoring together with the support services provided, should offer enough technical flexibility to satisfy these requirements.

In the study presented here the technical flexibility was sufficient to immediately satisfy most of the requirements coming up within processes of organizational change. Nevertheless, the implementation of the access rights was inappropriate for the technically supported voting procedure, the event service did not satisfy the needs of joint document typing and the display options for documents stored in a folder did not offer appropriate views for both, typing pool and operating section. All of these problems could not be solved by tailoring, they required a reimplementation within a new system version. As POLITeam is a design-oriented project, there is sufficient manpower to carry this out. It is doubtful whether groupware projects carried out in a non-research environment will have the resources for such a far-reaching reimplementation.

Two approaches seem to make sense in order to tackle this problem. The first approach just accepts the lack of flexibility and tries to muddle around the missing technical options by agreeing upon certain social protocols, which are based on the existing functionality. The second approach to tackle this problem is an increase in technical flexibility to reduce the efforts necessary to adapt the system. As already mentioned, the LinkWorks system on which the POLITeam I version is based, offers functionality to support quite a wide range of different tasks. Furthermore, it allows to adapt certain functions to create new system behavior by choosing between predefined alternatives to modify functions, by linking existing functions with the help of a scripting language, by overwriting parts of the program code. Finally, it allows to integrate external programs by offering an interface to have access to the system's database. To satisfy the requirements mentioned above, we had to develop and integrate external programs, which is the most resource-intensive way to adapt this application. Technical flexibility would be increased if the required functions were already provided by the application, or if their realization were more easy to carry out.

Apart from these requirements for the design of groupware applications, technical flexibility can be improved by an adequate system support. Depending on how complex it is to realize certain user requirements, system support could be provided by a multi-layered support hierarchy. Such a hierarchy consist of ordinary users, expert users, mediators, internal computer specialists, and external computer specialists. Whenever the lower layer of this hierarchy can not satisfy a new functional requirement, support from the next level of the hierarchy should be accessible. Okamura et al.'s (1994) study indicates that technically trained and organizationally recognized expert users - so called mediators - could

improve the technical flexibility of a groupware application. In a similar sense, Nardie (1993) has mentioned the importance of expert users - so called gardeners - in providing guidance to other users and tailoring an application. Similar concepts have been discussed by Mackay (1990) and Trigg and Bødker (1994).

Participation

Nevertheless, an evolutionary approach to organizational change and technically flexible applications is just a precondition for successful processes of organizational development related to the introduction of groupware. Based on the experiences reported before it seems obvious that the members of the affected organizational units need to participate. Without their knowledge about the actual work practice, it would be almost impossible to use the potential of groupware applications appropriately. Moreover it is important that actors in the change process have enough knowledge about the functionality of the groupware application, to be able to develop innovative concepts for computer supported cooperative work. The development of the new voting procedure illustrates how these two abilities must fit together.

As different members of an organization have their own perspective on cooperative work practice and as change in the patterns of cooperation may lead to conflicts among them, the participation of as many users as possible seems to be important. The naming and storing problems in the federal ministry indicate conflicts regarding the unanticipated consequences of organizational change. To adjust different perspectives and to handle conflicts, facilitated workshops have proved to be a very successful means within the POLITeam project. Minor conflicts like the removal of documents from shared workspaces could be solved directly, other conflicts could become manifest and preliminary solutions could be discussed. Thus, some of the people participating in such processes should have facilitative abilities.

Finally, it seems to be helpful to involve actors who already have experiences with similar processes of organizational change related to the introduction of groupware. Such experiences would be helpful to anticipate some of an intervention's consequences. For instance, Orlikowski (1995) reports on a similar reduction of the face-to-face-communication due to the introduction of groupware like it was perceived by employees of the state representative body. Though each organization obviously is an operationally closed system, it seems to be possible to learn from experiences made in other fields of application. A know-how transfer between different organizations seems helpful to support processes of organizational change related to the introduction of groupware. Such a transfer can be typically achieved by external consultants.

Interpreting these observations from a system-theoretical point of view, participative approaches, qualification measures, appropriated facilitation and know-how transfer seem to increase the likelihood for organizational innovations. These measures can be perceived rather as support for the self-organized internal processes of the system than as a perturbation of the system from the outside.

4.2 The Outcome of Organizational Change

Beyond the change process itself, we have to evaluate the outcome of this process by asking, in how far they have encouraged the organizations' ability for self-organized behavior. This question cannot be answered in a definite way two years after the beginning of the project, because in the federal ministry none of the cooperative tasks was fully supported yet. This is due to the fact that the higher levels of the organization's hierarchy are not yet equipped. In the state representative body only one task, the voting procedure, is fully supported. Looking first of all at the groupware functions which allow organizational innovation, interestingly it is not the electronic circulation folder, but the document-sharing feature on which most of the innovations are based. Thus the groupware related option to overcome the need for strict sequentialization of paper-based procedures seems to be a major source of organizational innovation. This source of innovation is reported by Hammer and Champy (1993), as well. Here again the quality of the irritation – the functionality of the introduced application – influenced its outcome considerably in an obviously non-deterministic way.

Nevertheless, the organizational changes we can see so far are of rather minor importance compared to the overall tasks of the subunits equipped. For instance in the federal ministry, the cooperation between the section manager and the other members of the section did not change considerably. By getting access rights to all the shared subfolders of his section, the section manager seems to use the increased visibility to improve his coordination ability by hierarchical decision making. Similar consequences for the relationship between middle management and its subordinates were reported by Orlikowski (1995). The relationship between the subunits equipped with the system and the upper levels of middle management did not change, because this part of the hierarchy is not yet involved in the project.

It seems doubtful, whether a widening of the fields of application will impact the modes of cooperation within the hierarchy of these organizations, especially because in the German government work processes are still prescribed by a set of formal rules originating in the end of the last century. Thus to promote organizational change towards an increased overall ability towards self-organized

behavior, the applying organization has to change its perception of the project and to focus explicitly on organizational development. In this case the introduction of the POLITeam system could be understood as a perturbation to initialize organizational change processes to overcome tayloristic structures.

5. Conclusion

This paper has analyzed two case studies of organizational change following the introduction of groupware from the perspective of the theory of self-organizing social systems. Luhmann's (1984 and 1995) concept of social systems has been applied to explain intra-organizational change processes. We had to perceive organizations and even parts of them as individual social systems. This leads us to a theory-grounded explanation of change processes related to the introduction of groupware. It becomes clear that a deterministic planning of these processes is inappropriate. If influence should be exercised on these processes, one has to proceed in a participative and evolutionary manner. Perceiving groupware as allopoietic systems, it becomes clear that technical flexibility is a key requirement for their design and embedment.

In discussing these findings, theory and empirical studies fit nicely together, whereas this is not the case for other observations. For instance, self-organization theory has problems to qualify different types of perturbations. Our findings indicate that different types of perturbations lead to different effects. With concern to organizations it is unclear how single social systems can be conceptualized and how to determine their borders. This is especially the case when analyzing participative approaches to organization development.

So the question remains still open whether the theory of self-organizing social systems will become a fertile base to de- und prescribe processes of organizational related to the introduction of groupware.

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