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EMANCIPATION OF AND BY COMPUTER-SUPPORTED COOPERATIVE WORK

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Abstract

Computer-supported cooperative work (CSCW) currently arouses plenty of interest. New types of applications have entered the market and new areas of work get computerized support. It is asserted in this paper that these technologies have potential areas of use also in other kinds of environments than what currently is typical. In order to approach the proposition, a conceptual framework is presented: collaboration is interpreted as coordination of organizational tasks. In accordance with the conceptual framework, examples of industrial uses of the CSCW-technologies are sketched. Three simplified classes of these technologies, using the terminology in a broad sense, are employed: electronic mail, hypertext, and calendar systems. It is claimed in this paper that the new uses of CSCW-technologies would, on the one hand, emancipate the industrial users from the environment of conventional applications and, on the other hand, emancipate the CSCW-technologies themselves from the restricted territory of office uses. The introduction of new types of technologies in work organizations is, however, not considered unproblematic. The application environment may develop into a complex one, and the benefits of the new technologies may become questionable. Such consequences and other implications of the broadened CSCW-domain are also discussed. Especially user support and organizational concerns are focused on.

Keywords: computer-supported cooperative work, electronic mail, hypertext, calendar systems, communication, coordination, collaboration, inventory management, user support.

1 Introduction

Computer-supported cooperative work (CSCW) currently arouses plenty of interest. New types of applications have entered the market and new areas of work get computerized support. The technologies that usually are regarded as relevant in connection with cooperative work actually form a certain category of computer applications. These are applications which are designed for several users but not necessarily for an unlimited amount of them. The application area is not a conventional one either. Sørgaard has given a characterization of computer-supported cooperative work and has defined the following factors as relevant: people work together due to the nature of the task, they share goals and do not compete, the work is done in an informal and flat organization, and the work is relatively autonomous (Sørgaard 1987). A similar set of criteria has been presented in (Goodman & Abel 1987). These criteria cannot be used as an exclusive definition of cooperative work. Such classifications provide us, however, with a good intuitive picture of what type of organization (of work) is being focused on.

The set of relevant applications may probably best be characterized by mentioning examples of the types of applications that usually are considered in the CSCW-context. These are, for example, electronic mail, bulletin boards, computer conferencing, calendar systems, hypertext, and notecard systems. An overview of existing types of CSCW-applications has been presented in (Bannon 1986).

In connection with the development and use of these technologies, a particular line of thought has been observed by this author. The contemporary sphere of relevance seems relatively narrow in at least two senses: either the community of active users is small (as well according to the amount of the users as the professions that are represented), or the task domain is "well defined", or thoroughly both. In relation to the above mentioned, two areas of activity can be identified: the academic domain and the office-environment. In the academic domain, the following activities appear central: co-authoring a book or other text, coordinating the work of a research project group, and facilitating computer conferencing. Electronic mail networks and hypertext applications become more and more common in office environments, too. It is claimed in this paper that a narrow-mindedness concerning the relevant uses of the CSCW-technologies is prevalent. It is also asserted that these technologies have potential areas of use in other kinds of environment than what currently is typical.

For the sake of clarity, three simplified classes of CSCW-technologies are employed in the remainder of this paper. These classes, using the terminology in a broad sense, are:

- electronic mail,
- hypertext, and
- calendar systems.

		Class of technology		
		Electronic mail	Hypertext	Calendar systems
Task domain	Strictly defined	+ (intention with certain messages)	+ (authoring text)	+ (coordinating meetings)
	Loosely defined	– (all messages sent and received)	–	–
Size of user group	Small user group	+ (shared task context)	+ (co-authors, secretaries)	+ (project groups)
	Large user group	– (all connected users)	–	–

Figure 1: A characterization of three simplified classes of CSCW-technologies with regard to (a) the scope of the task domain that is supported, and (b) the size of the user groups. The relevant uses of these technologies fall into the categories of strictly defined task domains and small groups of users. The uses of electronic mail seem unlimited at the first glance. However, in order to perceive the CSCW-criteria in a meaningful way, the focus must be sharpened. The group of users working "cooperatively" is probably not the group of all users who are connected to the network. The *actual group* communicates with something particular in mind (and in common). The size of a sensible task domain is also defined by this particular topic. Hypertext and calendar systems are typically used by small groups (like research projects, co-authors, and secretaries) for a strictly defined domain of tasks (like coordinating meetings and authoring text).

Electronic mail refers to network-based computer messaging systems by which users can address textual messages to each other. (See, for instance, (Eveland & Bikson 1987) and (Morgan & McGilton 1987).) Conclin has characterized hypertext as "...extending the traditional notion of 'flat' text files by allowing more complex organizations of the material. Mechanisms are being devised which allow direct machine-supported references from one textual chunk to another; new interfaces provide the user with the ability to interact directly with these chunks and to establish new relationships between them. ... Windows on the screen are associated with objects in a database, and links are provided between these objects, both graphically (as labelled tokens) and in the database (as pointers)" (Conclin 1987). (See also (Garrett, Smith & Meyrowitz 1986) and (Trigg, Suchman & Halasz 1986).) Greif and Sarin describe MPCAL which is a "multiperson calendar system for meeting scheduling and resource management. ... There are several types of calendars representing the schedules of a person, of a common resource (such as a conference room), or of open events such as seminars" (Greif & Sarin 1987). In accordance with these classes, the above mentioned restrictedness of the current uses of the CSCW-technologies is summarized in Figure 1.

The earlier mentioned limitations define the motivation of this paper. The main claims are two. First, the kinds of work and organization which could benefit from the use of the CSCW-technologies are more numerous than what the current research recognizes. Thus, new uses are proposed. Secondly, the eventual new groups of users may create/become part of unforeseen phenomena in terms of the scope of organizational interconnections. Thus, strategies for avoiding too complex information infrastructures must be developed.

The discussion proceeds as follows: In order to approach the proposition of defining new CSCW-users, a conceptual framework is presented. This is done in Section 2. The framework draws on three central concepts: communication, coordination, and collaboration. The application of these concepts originates partly from the author's empirical research work in the case organizations of the Knowledge and Work Project, partly from the characterization of cooperative work that was referred to in the beginning of this section. The conceptual framework is then used to argue in favor of unconventional uses of CSCW-technologies. In Section 3, some possible uses of these technologies in an industrial setting are sketched. The introduction of new types of technology in work organization is not considered unproblematic. The application environment may develop into a complex one, and thus the benefits of new technologies become questionable. Such consequences and other implications of the broadened CSCW-domain are discussed in Sections 4 and 5.

2 The Conceptual Framework

An important function in an organization is collaboration. Expressed the other way around, it is hard to imagine an organization function without collaboration with other organizations, between its own departments, within working groups, between individuals, etc. This has apparently been recognized by the developers of the CSCW-technologies, too.

In this paper, organizational collaboration is understood as the actors' work towards common goals and the achievement of these objectives. The nature of collaboration in the sense of how it is motivated or how the motivation is interpreted (cf. conscious vs. unconscious; harmonious vs. contradictory, etc.) is, however, not focused on. The further discussion is based on the conception of collaboration as an entity which can be analyzed in terms of its components at the lower levels of the conceptual hierarchy. The development of ideas is based on Nurminen's writings about (computer-mediated) communication (Nurminen 1988), and on the empirical research work of this author in the Knowledge and Work Project.

Following this line of thought, one possible perspective on collaboration is to interpret it as coordination of organizational tasks. There are, of course, several levels of such tasks, some of which cannot be regarded as human performances. This is the case in many industrial settings where automation has replaced the observable human acts of task coordination (and thus collaboration). These cases,

as relevant as they are, are not analyzed here. The discussion centeres around cases where task coordination can be understood, for instance, as an act of:

- transferring the *responsibility* or *control of performance* from one organizational unit (i.e., person, working group, or department) to another,
- giving or receiving an impulse (*triggering* action), or
- joining commensurable, material and/or information *objects* together, are discussed.

Task coordination, in turn, fails without some kind of communication. Explicit messages articulated between two individuals can be used to illustrate the communicative character of task coordination. It would be difficult to study the dimensions of collaboration by merely analyzing the coordination level. This is why focusing on communication is necessary, too. All communication is, of course, not coordinative. The following examples shed some light on coordinative communication:

- "Please, wait a second. I have not finished yet."
- "Could you, please, cancel the process, I have made a mistake."
- "You can skip this task, I did it yesterday."
- "Is it 'ok' to do this later?"
- "Now you can try again."
- "I am ready and waiting."
- "Do you have time to help me?"

Moreover, communication takes place under different conditions. For example, the topography of the communicating community may vary considerably. Communication may also be mediated by several types of media. The time dimension in a communication situation is often flexible, too: the rate of exchanging messages may alter frequently. Collaboration is thus a many-faceted phenomenon: it as well *requires* as is a *consequence* of practicing communication and task coordination.

In order to illustrate the amalgamate nature of organizational collaboration, some classes of communities in and between which communication, coordination, and collaboration occur, will be specified below. The topography of the community as well as some communicational, coordination-related, and collaborative aspects of work have been employed as classification criteria:

- Between two individuals: communication based on *agreements* about sharing information—sharing an *interest* or a goal.

- Between several individuals in a group: coordinating the work process of an *autonomous working group* with a common goal or a shared interest.
- Between two groups or departments, by two individuals: transferring the responsibility *from* a functional unit *to* the next one—a shared product of some kind is involved.
- Within a group or department, between two individuals: *impulse switching* within a phase oriented task chain where human specialization can be observed.
- Within a group or department, between several individuals: coordinating the phases of a work process where the performance of a *particular phase is multiplied.*
- Between an individual and a group or department: communication based on agreements about *sharing operational information.*
- Between an individual and an individual in a group or department: communication between the managerial level and the supervisory level (vertical control) or between *specialists* and non-specialists.
- Between two groups or departments in a functional sense: collaboration of organizational *units.*
- Within a group or department in a functional sense: collaboration between co-workers where the focus is on the *product*, but not on individual performance.

The "functional sense" expresses the possibility of a situation in which it is impractical to focus on communication between individuals, since the community operates as a solid functional unit, and individuals interchange very elementary messages. In other words, the individual is part of a group which has common goals, the fulfillment of which is not possible for single individuals, and where a particular individual does not make a difference. In general, more and more forms could naturally be pointed out or developed.

Other kinds of taxonomies are descriptive, too. For example, Damodaran reports an office survey where the following purposes of communication were identified (Damodaran 1986): giving information/advice, getting information/advice, decision making/problem solving, negotiating/bargaining, arranging a meeting/contact, and responding to a prompt. Communication for these purposes can be observed in most organizations, at all organizational levels, and within and between different functional areas of the organizations. For instance, decision making is typically considered a management function. However, the operational tasks in a manufacturing organization may be complex and include decision making as well. Within an organization, bargaining concerning, for example, the division of resources is often regular. So, communication facilitates various work

situations. On the other hand, similar work situations may occasionally require different types of communication. An example of this is a situation where the management of the material flow is more or less based on articulated agreements and established practises. This is adequate for coordination under normal conditions. However, in an exceptional or erroneous situation, negotiating and bargaining concerning rearrangements or recovery procedures become topical.

It was demonstrated that in an organization, the levels as well as the patterns of communication, coordination, and collaboration are many. Consequently, most borderlines drawn between "different" types of communities and "various" kinds of communication, coordination, and thus collaboration, are somewhat artificial, although frequently attempted especially in the CSCW-literature. In the next section, an attempt to fade such borderlines is made. This is partly done by placing some typical uses of the CSCW-technologies in the previous classification of collaborating communities, partly by giving examples of industrial uses of these technologies in the context of the classification. In this paper, the choice of terminology is also aimed at underlining this point of view: 'collaboration' instead of 'cooperation' (cf. CSCW) is applied.

3 Computer Support for Collaboration in an Inventory

As was pointed out in Figure 1, a good deal of the current uses of the CSCW-technologies can be described by two attributes: the task domain is relatively strictly defined, and the actual user group is usually small. In addition, the users are often academics, office workers, or executives.

In the previous section, a characterization of different collaborating communities was presented. In terms of those communities and the corresponding communicative and coordinative patterns, the contemporary uses of the CSCW-technologies can be interpreted as being located in the area of the first mentioned alternatives. For example, electronic mail is typically used for communication between two individuals or between an individual and a group. A common goal or a shared interest usually defines the group. Thus, the membership of a relatively small group appears central.

A hypertext application can, of course, be used by single individuals only, but in relation with collaboration, larger communities are focused on. In this context, the largest and at the same time the most sensible communities are those of two individuals or several individuals in a group. Authoring a text, for instance, is a meaningful activity only in a small group. In connection with text, communication is indirect: the document mediates communication. This point of view, in addition to the common goal of authoring text, defines the collaboration which is facilitated by (indirect) communication. A calendar system, in turn, is also a tool for a group of persons who share an interest. This interest may be a concrete goal, like a meeting, or a resource and its use, such as time. All in all, the conventional uses of the CSCW-technologies seem to escape the blue-collar environments. This author does not intend to speculate on the actual reasons

for this development. This observation is, however, the reason for basing the following case on an industrial setting. Thus, the emancipation of the CSCW-technologies from restricted territory of office uses is proposed.

This presentation draws on one of the case organizations of the Knowledge and Work Project. The organization is a firm in food industry. In this paper, the inventory management system is focused on. In short, what happens is: Food products are manufactured and packed. Some products have to stay in the quarantine and wait for an "ok" from the laboratory. Large amounts of products are long-term stored in the bulk inventory. The short-term storing of small amounts of products, and the distribution of goods take place in the buffer inventory. The workers of these organizational units collaborate tightly in order to manage the fluctuating material flow. Production statistics, quarantine management, product positioning in the bulk inventory, the FIFO-order of stored goods, storage book-keeping, and way-billing are all computer-supported functions. The workers have continuous access to terminals and printers. The support that the system provides is, however, aimed at facilitating bureaucratic information processing. The system is also rather static, and many exceptional, erroneous, and new situations require intervention in terms of manual procedures and temporary strategies. Typical examples of such situations are:

- A pallet enters the bulk inventory without a pallet label.
- A pallet label has a faulty product number.
- A shelf position in the bulk inventory is empty while the status information shows 'occupied'.
- A shelf position is full while its formal status is 'empty'.
- Products listed on a way-bill appear not to be available.
- Customers receive wrong products and/or wrong amounts of goods. In order to manage these disturbances, the following measures can be taken:
  - Pallets are taken from the buffer inventory back to the bulk inventory.
  - Pallets are temporarily stored in non-computerized subinventories.
  - Lots are shipped directly from the bulk inventory.
  - Pallets are consciously taken out of wrong shelf positions in the bulk inventory.

New exceptions, errors, and unforeseen situations are thus created. Increasing problems, both immediate and long-range, with, for example, the FIFO-order of goods and the storage book-keeping can be foreseen. Such incidents are, however, everyday occurrences in the inventory department. More detailed descriptions of the case organization are given in (Eriksson *et al.* 1987), (Hellman 1987), and (Niemelä 1987).

Here, the organization is clearly positioned at the end of the list of alternatives concerning collaborative communities (see Section 2). Two groups or departments are coordinating work tasks in a functional sense. Collaboration in a functional sense within a group also takes place: Co-workers focus on error-free and fast delivery of goods. (Storing the products is a secondary function while distribution is the primary one.) The dimensions of everyday work situations indicate that planning, decision making, and knowledge work tasks are as prevalent as the normal operational duties. These observations are in line with, for example, Kusterer's writings about the complexity of the above mentioned kind of work (Kusterer 1987). So, both the local group organization and the variation of tasks call for special support.

It will be argued below that the three basic types of CSCW-technologies, electronic mail, hypertext, and a calendar system, would fit perfectly into this kind of organization. The emphasis would be on supporting the *horizontal* organizational relations. The examples that are given are illustrated in Figure 2.

Electronic mail could, for instance, be used to prevent and manage the frequently occurring exceptional, erroneous, and new situations. Particularly the management of big amounts of export products requires special treatment in terms of temporary space arrangements and coordination of transports between the departments. Now, many of these situations suffer from inadequate support to the informal organization—especially with respect to the frequent communication between the packing unit and the bulk inventory. As the information processing which is connected to the management of the material flow takes place at the terminals (both in the packing unit and the inventory department), using electronic mail would be a commensurable way of communication. Commensurability refers to the medium: because the bureaucratic information processing is computer-supported, communication concerning these information processes should not require the change of medium. An example of this is the short-term management of export shipments: The goods packed for an export shipment are labelled in an unusual way; they neither get a position in the bulk inventory nor a pallet label indicating the physical shelf position in the bulk inventory. Instead, they are recorded as non-stored pallets, marked with a 'pass'-tag and often placed outside the physical inventory. This kind of exceptional arrangements require coordinative communication between the departments and working groups. Informing the colleagues about the status and position of the export pallets could happen by using the same media as what is used when recording the production. The information which is to be distributed is easily available (in correct form), it will certainly be received by somebody concerned, and it can be filed for future use. Neither phone calls nor notes possess all these qualities.

A hypertext type of application would obviously prove ideal in the management of the inventory itself. Several kinds of "views vs. levels of detail" are constantly needed, and realizing these by means of rapid pointers (like buttons) back and forth makes more sense than the use of conventional database applications with traditional user interfaces. The contemporary uses of the hypertext

applications are, as the name indicates, aimed at document processing. However, utilizing the idea in a broader sense is possible. The application domain does not have to be text—it may as well be an *abstraction* of an inventory. A pointer network, based on basic product information, could be supported by button pointers to the amount and position specific views. In addition, combining the up-to-date and historical data concerning these views could lay the basis for a powerful network of information. Such a network could prove useful in the management of exceptional, erroneous, and new situations.

In these organizational units there are several tasks which are influenced by the fluctuating nature of the material flow. Export shipments were mentioned as one example. Seasonal variations cause considerable fluctuation, too. Under these circumstances, the impacts on the work process could be regulated by the stakeholders themselves. A calendar system could be helpful when (re)arranging the physical conditions of the workplace or adjusting some "collective parameters" of the information system (which has a central role in connection with the material flow). The pallet positioning algorithm in the bulk inventory is one example. The algorithm influences the velocity (the rate of change of position) of the products, and thus acts as a coordination factor between the packing unit and the bulk inventory. So, two organizational units have to collaborate while, for example, the fluctuating material flow and nightshifts make it difficult to perform arrangements autonomously. Supporting meeting arrangements by the use of a calendar system might thus facilitate the autonomous and spontaneous organization of work.

The actual working practices in the case organization indicate that the above mentioned types of applications would support work in a meaningful way. Electronic mail is "simulated" in the real inventory management system by providing the users with free-format text fields in connection with certain file "records". These fields can, for instance, contain messages about unusual procedures that have taken place when treating product pallets. In the packing unit, for example, manual records of packed products and corresponding amounts and dates are kept. These note books and cards ensure the possibility to compare and summarize when straightening out occasional messes. A "hypertext kind" of manual pointer system is clearly observable.

To sum up, it is suggested that the industrial users could, by the use of CSCW-technologies, be emancipated from the restricted environment of conventional database applications. The introduction of new uses of technology may, of course, create new problems. In the above mentioned case one problem could be the increased in the complexity of the information infrastructure. Preventing or at least managing the creation of such circumstances is discussed in the next section.

4 Increasing Complexity

In the future we can expect to be confronted with situations in which a user, trying to cope with her ordinary (information) tasks, gets confused by the complexity of local and global task coordination. These tasks will probably have

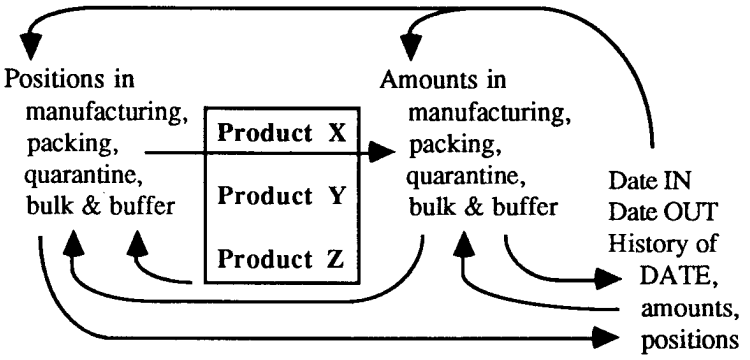
	Types of functions or tasks that could be supported by CSCW-technologies in a manufacturing organization's inventory department
Electronic mail	THE PACKING UNIT TO THE INVENTORY DEPARTMENT: "These products are repacked, not new. Please, take this into account when placing the soon arriving pallets in the inventory. They must naturally out first!" THE INVENTORY DEPARTMENT TO THE MANUFACTURING DEPARTMENT: "We have occupied a reserve space downstairs for a special shipment. It takes only a couple of days. Please, do not remove the pallets!"
Hypertext	
Calendar systems	MEETING ANNOUNCEMENT. Main topic fixed. Time open. Meeting groups open. TOPIC: Better functioning and more flexible material flow management between the manufacturing department, packing unit, and quarantine, bulk, and buffer inventories. (Modifications to the computer system? New division of labor and responsibility? Self steering groups? Night shifts? Reorganization of space usage?...) PARTICIPANTS: All workers of the above mentioned departments and units. In groups? TIME: Before holiday season, and hopefully between 7.3.-25.3.89.

Figure 2: Examples of the possible uses of the CSCW-technologies in an inventory management system. Electronic mail could be used to coordinate the fluctuating material flow in the interface area between two departments. A hypertext application could be used to implement an inventory system itself. It is often the case that moving dynamically between different types and different levels of detail of data is a desired feature. A calendar system could be used to arrange working group meetings in order to organize the work processes.

computerized support, or they will be performed in connection with the use of a computer. A broader use of the CSCW-technologies, on the one hand, and the numerous use options of other applications, on the other hand, may contribute to the development of an enormous information infrastructure. The use of electronic mail systems alone may create unclear situations, and it is thus used as a starting example to illustrate this assertion. Below, only serious uses of electronic mail will be discussed.

For example, a common electronic mail function is the 'carbon copier', cf. `~c` in Unix-mail (Morgan & McGilton 1987). It is easy to send identical mail to several persons at the same time. Sometimes there is no way of knowing who else, in addition to "me", has received a copy of the message. Some mail systems even include special 'blind copy' functions which can be used for hiding other receiver(s) of a copy, cf. `~b` in Unix-mail (Morgan & McGilton 1987). Moreover, the receivers of a copy may decide to forward the mail to still other colleagues.

Sending mail to a group is also possible. When electronic mail groups are being established, everybody concerned usually knows about her being a member of a group. The complexity increases when a person becomes a member of several (possibly partly overlapping) groups, or when new members are added to groups without explicitly informing the original group. Sometimes one is allowed to know the composition of a group, but this is not always the case. If copy functions and groups are combined, and some restrictions are employed, quite hairy networks of communication can be composed. In other words, electronic mail networks are *explicitly allowing* collaboration, but *implicitly* used to *define* groups of users communicating with each other. In addition, although Eveland and Bikson report that electronic mail is mostly utilized by those persons who *already* know each other and thus communicate frequently (Eveland & Bikson 1987), Feldman suggests that also new connections—so-called weak ties—are established (Feldman 1987).

Another interesting example of the dimensions of electronic mail is the eventual use of stored information. At a point of time, a user may store or update information located in a database. This information may then, after residing in the database for some time, be used by a totally different group of users working for quite other purposes—for example, for reporting. The messages that people send may contain, for instance, reports which have been incorporated by the mail system's "insert file" function, cf. `~r` in Unix-mail (Morgan & McGilton 1987). The complexity of the situation is not observable at the sending end only. The received information may, firstly, have an important immediate function in the task flow of the receiving user. Secondly, the receiver may store the information for further use, whatever this might be. These persons, maybe distant in time and space, take part in communication. The database has now the role of a communication channel. Computer-*mediated* communication is indirect, and thus the mediator disappears, cf. (Nurminen 1988).

Thus, a network of organizational connections is established *by* the use of the information system, and the network covers both horizontal and vertical rela-

tions. But, irrespective of whether we focus on traditional information systems in general or on special applications for computer mediated communication in particular, it is rather cumbersome to distinguish the communication, coordination, and collaboration partners from the mass and from each other. In other words, *who* is at the other end and *how*?

The following scenario of an inventory system, where both an electronic mail system and a database have a mediating role, is realistic: 1. A manager gets a report concerning problems in raw material purchases and product velocities. 2. She decides to choose an alternative strategy. 3. She, among other things, updates some fields in the corporate database. 4. Then, she uses the electronic mail network for broadcasting information about the changes that have taken place. 5. The inventory department's users change the parameters of their inventory application accordingly, and inform the packing department's workers about these changes. 6. It may be necessary to perform stock taking before the system can run according to the new parameters. The new material flow events in the inventory are recorded in the database, and can, when the time comes, influence some decisions again. 7. The inventory's usage of physical space is, from now on, different than earlier.

It is often the case that only *direct* communication is regarded as existing. The computer is not considered a means to communicate, but rather a machine being talked to. In the case of a database, the computer system's role as a mediator of organizational communication is partly invisible since (a) the user interface does not usually indicate that there are other users at the other end of the chain of events, and (b) the users probably take it for granted that they are exchanging information with the database which apparently contains attributes of entities instead of objects with a context and meaning. This is an important topic in connection to the use of CSCW-technologies which usually are regarded as facilities for supporting direct communication.

As can be concluded from the discussion concerning user communities and computer mediated communication, it is difficult to distinguish between different types, purposes, or instances of communication, coordination, and collaboration. In such complex situations it is in everybody's interest to improve system perceivability. In the next section, some possibilities for comprehensive user support are presented.

There are, of course, also other kinds of possible consequences of the introduction of CSCW-technologies than those mentioned above. One example is the organizational conditions and changes in these. Organizational concerns are also discussed in the next section.

5 Implications and Discussion

5.1 Maintaining Perceivability

As new kinds of communication and collaboration networks constantly enter the organizational scene it becomes more and more important to support the user so

that the context, dimensions and possibilities of the use situation are perceivable for her. There are lots of systems and applications where the problem of throwing people into confusion is not so obvious, although the application domain may be very large. For instance, document processing, project scheduling, and electronic mail systems spread their roots in the whole organization, but do probably not cause immediate system imperceivability. Computer-supported cooperative work was separately discussed earlier. It was pointed out that, for example, the use of electronic mail may create complex communication topographies. In order to maintain the perceivability of an information system, especially when its complexity may be expected to increase, special attention to user support has to be paid.

The research work of the Knowledge and Work Project has lately focused on user support. It has been asserted that in a complex use situation an *adequate* support system contains a *notion of context.* Otherwise, perceiving the highly social character of organizational information processing is difficult. In the following, some approaches to contextual user support are briefly reviewed. First, it is argued that it is important for the users to perceive the organizational context of their work (like the connections of their tasks to the tasks of other workers). The second claim is that the complexity of the use environment can be reduced by realizing support systems which draw on the above mentioned argument. Some approaches to contextual user-support can be found in the literature, too. Below, a few examples will be given.

Lutze presents an approach to a contextual help system in a task context (Lutze 1987). He distinguishes between the following help services: situational services (explaining the current situation of the task), actional services (supporting, e.g., the understanding of presuppositions, effects and consequences), comparative services (e.g., contrasting actual achievements and original intentions), categorical services (performance classification), locative services (emphasizing the summarization and abstraction of the most relevant parameters of a task situation), and illocutive services (extracting, elaborating and completing the user's goals with respect to his original intentions). The "context" must here be interpreted as refering to information processes.

Coutaz presents a concept of context, too (Coutaz 1987). Now, the environment is object oriented dialogue design where the design is based on the three-fold structure of abstraction, presentation and control. The control part of the structure keeps track of the linkages between the abstract (or formal) descriptions of the objects on the one hand, and the objects as they are presented to the users on the other hand. The context part maintains contextual information which is composed of the following categories: history, help, explanation, customization, and multi-threaded dialogue. A concept of context is thus introduced in accordance with information objects. The context does not, anyhow, yield the conception of work tasks.

Also Reichman provides some valuable notions about context support (Reichman 1986). She asserts that context support entails two things: knowing when

things should be interpreted together and knowing when things should be interpreted separately. In addition, it is necessary to provide visual reflection of interconnection.

All these approaches contain relatively powerful ideas of context. Nevertheless, organizational aspects like collaboration appear not to be fully reflected. In order to complement the above mentioned perspectives on context, a conceptual construct for context support systems has been developed in the Knowledge and Work Project (Hellman 1988). Below, a short description of this model is presented.

As was discussed earlier, communication may be regarded as the collaborative "glue" in an organization. Communication may also be interpreted as a set of information relations. People relations (task coordination and organizational collaboration) may thus be reconstructed by using the information relations. This train of thought can be converted into a data-structure kind of construct (whatever the mode of physical implementation might be). The following type of concept chain lays the basis for the realization of conceptual support systems: [organizational unit]$_i$ — [person in job]$_i$ — [work task]$_i$ — [task-connected information]$_i$ — [information object]$_i$ —— [information object]$_k$ — [task-connected information]$_k$ — [work task]$_k$ — [person in job]$_k$ — [organizational unit]$_k$. The results of inquiries might then be presented, for instance, in terms of information, task, and people relations. It would thus be possible, using the above sketched construct, to illustrate, for example, the coarse task flow of a job, a detailed description of an information object and its relations to other objects, a composition of a working group in terms of jobs and their definitions, or the like.

A context support system would, for instance, make it possible for the users to study with whom they actually collaborate when they perform some, at the first glance simple, information processing tasks. The fact that questions like "where did this piece of information come from", or "who will be influenced by this operation" can be answered has concrete consequences. In a situation where the correct course of action is not known, it is practical to be able to ask what happens (and to whom) if this-and-this is done. First, as these questions can be posed to the support system, the spreading of risky transactions can be reduced, and thus alternative solutions developed. Second, exceptional transactions which people normally would hesitate to perform, might be executed if the support system could tell that no seriously harmful ones would be carried out. This is not only a question of understanding or not understanding, or computer-supported cooperative work or not. It is a question of ways and possibilities of experiencing work as a manageable and meaningful activity, and thus a question of the quality of computer-supported work in general.

5.2 Organizational Concerns

Support to horizontal activities is admittedly of controversial nature. In addition to all intermediate forms of opinion, two opposite ways of thinking are prevalent in the literature. Robey writes: "Most literature dealing with computers and organizations has been concerned with vertical authority and control issues. There has been relatively less concern about horizontal differentiation, or the lateral complexity of organizations. Since many administrative problems arise over the control and coordination of different subunits, the relationship of the computer to this aspect of structure is of considerable interest" (Robey 1981). Conrath, on the other hand, has the following approach: "While 'better' communication, in the sense that it may be more 'open', may be the consequence of the use of electronic mail, this may not be viewed as an improvement by the management. Managers may now have much greater difficulty maintaining the same degree of control that they exercised before" (Conrath 1985). Olson and Lucas have articulated the very core of the ongoing process: "... employee attitudes, management processes, interpersonal relations, interdepartmental relations, and organizational structure will be altered by automated office systems through intervening changes in the locational and temporal definition of work, shifts in the mode and timing of communication, and changes in the work product itself" (Olson & Lucas 1982). This perspective appears realistic.

The point of view presented in this paper is that sophisticated computer applications, especially the use of CSCW-technologies, should be accessible to all members of an organization. Moreover, if the particular persons desire to apply these technologies, the prerequisites for and patterns of use should be tailored to fit the local environment. The prerequisites are, for instance, educational aspects: the (future) users need to be able to reasonably evaluate the available applications and the possible ways of use. The patterns of the (future) use are also to be assessed, for example, with regard to the definition of the user groups and their exclusiveness. Desperate fears of losing control, or stereotypical ideas of users who would not be able to utilize this kind of tools in the first place, are old-fashioned. On the contrary, effective and efficient functioning of organizations, and more than anything else, making jobs more interesting by offering tools for complex tasks (which also exist at the lowest levels of most organizations!), should be self-evident directions of development.

There is naturally the other side of the coin, too. It is easy to exaggerate with the use of new technology. "Technological enthusiasm" does not become any more acceptable when the CSCW-applications are introduced in the context of this paper (see Section 3). Anyhow, such uses are considered more democratizing than overpowering by this author. This is due to the types of tasks that become supported.

The amount, timing, and structure of information served to the users must also be considered. Hiltz and Turoff have written warning words about information overflow exactly in the case of computer mediated communication. They

also point out that good results and experiences are to be awaited if small task-oriented groups and communities of interests are supported (Hiltz & Turoff 1985). This is the case in the examples of Section 3. In an inventory environment—and probably other industrial settings as well—where people are primarily working with other tasks than information processing, this issue is very important. The nature of the CSCW-technologies is such that the users can, to a high degree, retain control of the extent and purpose of the use without too many rules concerning, for instance, the format or length of messages sent from outside (cf. (Hiltz & Turoff 1985)). For example, the users of electronic mail might choose not to participate in different news groups, but to use the application for explicit work-related purposes. It can also be interpreted that support is thus given to activities which may be classified as belonging to the area of informally organized work where autonomous arrangements are "default values". Even though the global organization could be classified as being a hierarchical organization, the formation of various local organizations is more than probable. A group which functions autonomously may have a very antibureaucratic internal organization of work, see, for example, (Ciborra 1983). The same goes for groups which are groups in the sense of electronic mail connections.

As a conclusion, there is a need for more research in the area of computer-supported cooperative work. New kinds of user groups may enter the scene, and the applications and the surrounding information systems have to be tailored to fit into their praxis. Also the large groups of users that exist and will be created need special attention. The organizational context in which the use takes place has to be focused on. This assertion is in line with Howard's text about a special type of skill in connection with "collective work". He emphasizes the importance of "the capacity on the part of members of a work organization to systematically reflect upon their own organizational practice and to engage in the on-going modification of work procedures and tasks" (Howard 1987). The context support that was proposed in the beginning of this section facilitates the formation and maintenance of such skills in the context of use of the CSCW-technologies.

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