Computer-Supported Cooperative Work: A Brief Introduction

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1. Preface

The way people perform their everyday work activities and how they can be supported through the computer systems they use is of particular interest to us at EuroPARC. This has led to involvement in an area that has come to be called Computer-Supported Cooperative Work, or "CSCW". The CSCW field is still embryonic, and CSCW is still in a sense an “umbrella term” for a variety of concerns about how to support multiple individuals in accomplishing their work through and with computer systems. A number of other terms have developed which overlap partially with CSCW concerns - e.g. Workgroup Computing, Groupware, Computerized Team Support. More recently, some effort at delineating the field has begun, although it still has not become a specific body of reasoning - a discipline if you like. Despite this, a considerable corpus of material has now been or is about to be published under its aegis. The purpose of this short report is to provide a brief account of the field, its origins, examples of the kind of computer applications included under its rubric, and some remarks as to possible directions of CSCW in the future, and ends with some suggestions for further reading for those whose appetite is whetted.[1]

[1] It is also our intention to produce a more in-depth report in the next few months on the possible role of ethnographic studies, as distinct from other sociological approaches to work, in contributing to the design of CSCW artifacts.

2. Origins

The term Computer Supported Cooperative Work is relatively new, having been coined by the computer scientists Irene Greif of MIT (now at Lotus) and Paul Cashman of Digital Equipment Corp. in the early eighties. The birth of the "movement" can be dated to a small Invited Workshop organized by them in August, 1984. It brought together a number of people from somewhat disparate areas, e.g., office information systems, hypertext, and computer-mediated communication to name a few. [2] The first open conference with the title Computer-Supported Cooperative Work was organized for December 1986 in Austin, Texas, attracting around 300 people. Participants heard about 30 papers on such diverse topics as : experiences in introducing computer conferencing systems; experiences with computerized meeting rooms; design and use of electronic mail filtering tools; design and use of shared calendar systems and problems of collaborative hypertext. In the next (1988) conference in Portland, there was an interesting shift towards concern with the nature of the design process, with a number of papers, especially the Scandinavian ones (6 of the 30 presented), addressing the issue of user involvement as a prerequisite for quality design. At the first European conference (September 1989), the quite different "world views" of CSCW participants was more apparent, with a separation between those groups focussed on modelling and design of office communication systems and those interested in developing a richer understanding of cooperative work practices. Not only were the goals different, but the language and methods used were also quite distinct, leaving some individuals quite confused as to the "core issues" of the CSCW field. Despite this, interest in the area has grown steadily, in both Europe and North America. These differences in perspective continued to manifest themselves at the most recent conference (CSCW'90) in Los Angeles. One noticeable development here was the increased participation of Japanese researchers and designers, and it is probable that many new applications will come from that country in the future.

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[2] Those present included Doug Engelbart, Clarence Ellis, Randall Trigg , Tom Malone, Murray Turoff, Robert Johansen, Carl Hewitt, among others.

3. CSCW - Why Now ?

The increasing importance of these conferences and the growth of the literature and research in the field attest not so much to Greif and Cashman having hit on some brilliant new idea as providing a label for a confluence of events, trends and developments occuring at the beginning of the 1980's. Changes and developments in technology, especially in networking, made system designers aware of new possibilities; the scale of investment in information technologies was such that 'users' were beginning to demand more effective support for their daily work practices that involved significant interaction with colleagues; there was a dissatisfaction with the then current views and models of office automation, and new views on the nature and techniques for the analysis of office activities were emerging. For example, Lucy Suchman at PARC was introducing sociology to the design process, bringing to the fore such things as the artfulness and skill routinely deployed by office workers in accomplishing their work (e.g. Suchman, 1987, 1989). These skills had been previously ignored by designers.

The result has been a heightened awareness by system designers of the need to support not just individuals, but ensembles and groups of users; more generally, a recognition that in most work situations the accomplishment of work involves multiple individuals, together with their computer-based tools, and that many inefficiencies in work practice stem from the currently inadequate computer-based support for the interleaving and sharing of tasks across people and machines.

There are a number of ways in which this interweaving between the social and the technical can be facilitated. In terms of developing a better technological infrastructure to support cooperative work practices, the work on distributed computer systems has a contribution to make. Likewise, for small teams of people working collectively together, some "groupware"[3] products can be of assistance. But CSCW is intentionally more than these, as its focus is the support requirements of cooperative work forms (Bannon & Schmidt, 1990). The field has emerged as an interdisciplinary program of enquiries and system design pooling expertise from sociology, organisational analysis and other social scientific approaches, software

[3] See Ellis et al, 1988 for a discussion of the meaning of 'groupware' .

engineering, hardware design, communications technology, to name but a few of the main contributory fields. It is more than distributed systems in being sensitive to the subtleties and complexities of collaboration, providing support that enhances rather than simply reflects that collaboration, and broader than groupware which is focussed on software to support multiple user applications[4].

4. Types of technology

CSCW applications can be grouped along a number of different dimensions. Many of the attempts to do this turn out to be mere taxonomic exercises, as we still are unsure of the key dimensions! Some distinguish between applications that provide support for synchronous vs. asynchoronous collaboration, and an orthogonal dimension that concerns whether the support is for people who are co-located vs. remote from each other. Here we make a simple separation between systems that are intended to aid everyday desk-top activities (the relaying of information and directives, the management of calendars and so on) and more novel technologies.[5] The former, with one or two exceptions, have been by far and away the most successful in terms of take up, but at the same time, in many ways, are the least radical or innovative[6]. More novel technology, and by this we mean systems that are unusual in their configuration or purpose and which mix types of technology, have not spread from the research domain. These include meeting support technologies; a variety of shared editors, design tools, and other supports enabling software development, collaborative writing and research; and last, systems that redistribute the social space of work, increasing 'interconnectivity'.

4.1 Supporting desk-top activities

Electronic mail (e-mail) is the clearest example of a CSCW application that has had a significant impact on the work place. Indeed some argue that it is the only successful CSCW application (Kraut, 1990), yet it predates the whole field of CSCW (*qua* CSCW) by many years! Having the ability to send messages electronically to people

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4 At present advocates of groupware work within the CSCW field, but it may be that they break away to form their own distinct research area. They have related, but somewhat complementary perspectives.

5 This is just a rough distinction we find useful currently and does not have any formal status.

6 One area of CSCW type systems used on the desk top we do not discuss here are Group Decision Support Systems (GDSS). See Kraemer & King: 1986: 353-375.

connected either via a local area network or a wide-area network around the world has undoubtedly given new opportunities for forms of remote collaboration undreamt of in the past. The relative speed and asynchronous form of the communication allow for new possibilities that are not equivalent to other media, just as, more recently, the explosion in fax systems has produced. Even within a particular department, where people can communicate face-to-face, e-mail can offer additional possibilities for communication and collaboration[7]. Whether e-mail is viewed as a groupware or CSCW application or rather a substrate for more complex applications (see below) has been the subject of discussion (see Grudin, undated). Our view is not concerned with this question other than to reiterate that CSCW should not be defined by the technology applied, but by its role in supporting cooperative work practices. Let us look at some enhanced e-mail facilities that have attracted attention in the CSCW field, and use these examples for making some observations.

Information Lens

The Information Lens system developed by Tom Malone and others at MIT has received a lot of publicity and is being developed into a commercial product (Malone et al., 1987). The system is designed to support people in managing their electronic mail. It has at times been referred to as an "intelligent" information sharing system. The filtering available in Information Lens is designed to screen users from "junk" mail and "filter in" other messages of interest, even if not directly addressed to these specific users, thus extending the information sources available to individuals. It provides capabilities for organizing mail based on various aspects of the incoming message. It allows users to make message templates of various forms and have rules (of an IF-THEN-ELSE variety) that act selectively on these "semi-structured" messages. If the sender has selected a *colloquium* form for the mail message, and a message form of type: *colloquium* has been defined by the group, then the sender can be provided with support for composing the message through a partially filled ("semi-structured") message template, and the receivers can make rules that utilize the information that a message is a colloquium announcement to file it appropriately. One can see how this could be quite useful to help put some structure on the myriad of different forms of communication which at present are insufficiently

7 See Bannon, 1986 for some discussion.

disambiguated. It helps the sender to structure messages appropriately, and can serve a reminder function for what information is necessary for certain announcements (eg. to remember to specify the location of a meeting!) as well as helping the receiver to sort incoming mail appropriately, rather than, as at present, have all kinds of messages mixed together in the incoming mail file.

However, the extent to which the original design intentions of the system have been met is an open question. One general question about such a system is, can we specify rules that work automatically to a useful degree in any real-world setting?[8] In an empirical investigation of the use of a prototype Lens system, Mackay (1990) found evidence that users could create and use rules appropriately. However, she also showed how important it was to allow for flexibility in the system so that users could decide when to activate the various sets of rules, rather than have this pre-ordained. This supports the notion that it is very difficult for people ahead of time to specify clearly the conditions under which certain rules should be run. Luckily, through a debugging feature, the prototype technology allowed one user to discover how to manually "trigger" a rule-set, and this feature spread to other users, and was subsequently incorporated in the next prototype although this was not part of the initial idea of how the system would be used. Thus the extent to which the results of the case study support the wider visions of some of the supporters of Information Lens about the use of autonomous agents is still open to debate.

The Coordinator System

This commercially available system is one of the most talked about CSCW applications (Winograd, 1986: 203-220; Bikson, 1988). It has strong advocates in the commercial world who claim that use of the system has increased their productivity enormously. It can be naively described as a fancy electronic-mail-cum-project-management system, built on the belief that human action is based on conversations, primarily *conversations* of a particular form, *for action*. Thus people using the system do not simply send mail, but make requests, or promises, or offer or decline to perform certain activities. (The system does allow for "free-form"

8 At CSCW 88 one delegate commented on a presentation where an example of a useful rule was "all messages from my Manager to be put in the URGENT folder" by saying that the last message he had from his Manager was to return the dishes to the kitchen, and he did not want this to be filed in his URGENT box! The example, while amusing, raises a serious issue about generality of rules.

responses, but this choice indicates abdication of the underlying framework on which it is built). Within this framework, the system then keeps track of the commitments made by individuals.

Whether the theory of language upon which the Coordinator is based is an adequate account of how people actually communicate is doubtful [9] but, as Robinson (1989: 79-114) notes, the main complaint against the system in use has been that it seems to exclude negotiation. The conflicting case study reports of its use (Johnson et al, 1986: 343-352; Bikson, 1988, Bullen & Bennett, 1990a) can be reconciled if one notes that it seems to work well in organizations with a rather rigid, traditional hierarchical management style, and be unacceptable in more fluid, losely coupled organizations. Grantham & Carasik (1988) claim that "The Coordinator makes explicit and textual a dimension of human communication which is otherwise contained in the overall context of interaction. It further makes the unsupported assumption that participants in the system will willingly share the designer's view that one SHOULD be extremely explicit about the nature of one's utterances. " (cited in Robinson, 1989: 74-114). For some groups, this application is regarded as having a prescriptive and narrow view on the nature of human language use, and has been rejected quite vehemently.

Shared Calendar Systems

There are a number of research-oriented and product-oriented CSCW systems that incorporate a shared electronic calendar system allowing for an automatic meeting scheduling capability. Although the concept appears attractive, there are some interesting problems in practice, outlined in the case study work of Ehrlich, (1987: 340-357) and Bullen & Bennett, (1990a; b: 291-302) and developed further in Grudin (1988:85-93). To summarize their arguments, electronic diaries cannot replace paper diaries, as they are not portable, nor do they give the same flexibility and utility possible through use of post-it notes, signs from different coloured pens, clippings, etc., often found in physical diaries. Another problem is that basically all of the people on the system must commit to using the system, i.e. to updating their diaries, before the system can really be used. If only half the group do it, nobody can rely on the system. Yet it is not at all clear what the benefits are to some

[9] A number of theories of language have been proposed in the literature the idea being to use these theories to model conduct and collaborative behaviour, eg. Bowers and Churcher, 1988:125-140.

members in keeping their electronic diaries updated, as the main benefits accrue to senior managers who call meetings (and/or their secretaries). The tradeoff between the work required and the benefits accrued are not equitable. Even if every one commits to do this, there are still problems about giving up control of one's " free" time. As Grudin argues, free time is not really free. Managers may be willing to have their time scheduled for a meeting with their superior automatically, but not the reverse. It all depends on what the situation is, if somebody is willing to schedule a meeting with certain people. Just as we saw with the Information Lens, people wish to have control of the situation, as thus will often wish to change priorities depending on the situation and their personal context. What would appear to be a relatively trivial affair, meeting scheduling, in practice can involve quite complex, and rapidly changing decision rules that cannot be clearly defined in advance of the actual situation. Ehrlich notes that in cases where electronic calendars are used heavily, the role of secretaries in screening meetings is often crucial to making the system work, so that the meeting scheduling involves negotiation between people and is not automatic. These experiences should make us aware, if we are not already, of how apparent technological fixes to what are social and organizational problems can come unstuck.

4.2 More novel applications

Amongst the claims of CSCW is to provide a greater sensitivity to social and organisational issues and a broader conception of the role of technology in organisational life. Systems to support meetings, co-authoring and editing, and transforming the social space of work illustrate just what this broader conception and sensitivity might mean in practice.

Xerox PARC's CoLab

The Colab project was a computerized meeting environment to support small (2 to 6 people) face-to-face meetings (Stefik, Bobrow et al, 1987: 147-167; Stefik, Foster, et al, 1987: 32-47). The room consisted of up to four specially designed tables arranged in a U-shape facing a large screen at the front of the room. Each table had on it a display, keyboard, and mouse. Each display was connected to a separate processor and these were linked by an Ethernet network. Additionally the displays were connected to a large screen, the "liveboard", by a video network. This network was used to project a user's screen on to the liveboard.

A number of software ideas were developed for Colab allowing users to jointly work in a variety of ways. These included facilities enabling users to share the same views on documents (WYSIWIS - What You See Is What I See) and tools like Cognoter, to support brainstorming activities. Studies of the use of Colab have helped to develop better meeting software -e.g. ideas on how to handle various forms of access collisions, as well as serving to heighten the importance of how social factors can selectively mediate the use of the technology (Tatar et al, forthcoming)

Cognoter, for example, implemented a three part process of brainstorming, organising the ideas thus generated into sequences or groups, and evaluating them. It allowed participants to work on their computers in parallel, using the keyboard and mouse whenever they wanted to. Collaborative use of this tool was found to be severely restricted by communications breakdowns between users. Users encountered difficulties coordinating their conversational actions and determining that they were talking about the same objects in the workspace (Tatar, et al forthcoming: 1). More specifically, there were difficulties over turn-taking in conversation, and these seemed to derive, in part, from differentials in information available to users, and to unpredictable delays in the relay of information through the system. **Cnoter**, a revised version of the co-authoring facility, was intended to remedy these difficulties by making shared editing more like a conversation [10]. Specifically, it allowed for a greater commonality of information between users. There were no longer private windows, editing became public and done in turns, windows became the same on all screens.

The importance of these social factors led researchers to the realisation that the conception of meetings that underscored Colab was too limited. Tatar, Stefik, and others, suggested that one can think of meetings as conversations. From this view, meetings can happen almost anytime and anyplace. People adapt their circumstances to suit their needs (Stefik & Brown: 1987). As a result, meetings support tools available in Colab, like the liveboard, have now been located in a numerous places in

[10] Athough quite unlike the kind of conversation Winograd had in mind in the Coordinator.

PARC enabling individuals to use them in meetings that they create as part of their working activities - where ever they may be[11].

Use of Video and the social space of work

The development of multimedia applications has stimulated renewed interest in how video technology can be harnessed more effectively in CSCW applications. While specialized videomeeting rooms have been in existence for a number of years, the promise of the medium has not, until now been realised. A number of research projects have been involved in using video to support both formal and informal interactions and towards the transformation of the social space of work. One of the larger was Xerox PARC's **Media Space** project (Goodman & Abel, 1986:246-253; & Undated; Olson & Bly:1991).

Between 1985 and 1988 Xerox's System Concepts Lab (SCL) located employees at Palo Alto and Portland, Oregon, to encourage the lab to focus on issues of interpersonal computing in a geographically distributed organisation. Media space, developed as a tool to support collaboration between these two sites, was a network of video, audio and computing technologies. At first this involved video and audio connections between the 'Commons" in each site, but within a year a video switch was introduced allowing every office to be connected with any other on both sites.

The purpose was to learn baout the nature of collaboration and to experiment and develop tools for its support. In this sense the media space was not so much a test of theories or technology as a 'tinkering about' (Olson & Bly, 1991). Over time, an increasing emphasis on design activities rather than collaboration in general emerged. Amongst the topics examined were a shared object data base and shared drawing activities. It was discovered that the process of drawing is often as important as the drawings themselves (Bly, 1988: 250- 57). But perhaps the most important lesson was that talk was the most crucial aspect of collaboration in the design process. Through talk decisions were made about what had to be done and who had to do it; through talk ideas were mulled over and refined.

11 Again the idea of conversation has appeared in CSCW. One has to be careful though about what each use of the term means; there are importnat differences between the speech act theory that loosly underpins Coordinator for example, and the general conception of conversation and social order that underpins the ideas of Stefik and his colleagues.

Many ideas derived from Media space inform current research. For example, making video connections symmetrical, i.e, if someone can see you, then you should be able to see them, (a central feature of the Bird-Dog experiment at EuroPARC[12]) was discovered to be the socially acceptable way of using video technology in the Media space. Above all, Media space made reseachers recognise the importance of informal, intellectual exchange.

At Bell Communications Research, the **Videowindow** project was an attempt to facilitate this kind of informal interaction (Fish *et al*, 1990:1-13) [13]. Set up on two separate floors of the Bellcore lab, the videowindow consisted of a high aspect ratio video channel and associated cameras, full duplex audio channels and two screens some 3' by 8'. These facilities allowed for life size images of individuals to be shown, and the audio for some sense of the spatial location of the individual. The videowindow was simple to "use": someone saw another at the other 'end' (i.e. on the screen) and simply drew attention to themselves by speaking; the microphones were placed to pick up all audio within range of the cameras. Surprisingly, Fish and his colleagues noted that interaction only occurred in 17% of the potential opportunities (when 2 or more people were visible at opposite ends of the "window") to do so over a three month trial period. This was much less than expected. In a survey users drew attention to the following problems. The system made private conversations difficult to achieve and maintain - there was no opportunity for a quiet aside, a whispering in someone's ear, for example. Users also found it difficult to finish conversations, although they were not sure why. It was suggested that the normal cues in conversational interaction were missing or somehow affected[14]. The researchers themselves also thought that the potential users were unwilling to try out the new system preferring instead to use the old and tried methods of informal interaction, tapping on someone's door, bumping into them in the car park and so on.

Research on how best to utilize video in supporting collaborative work practices is continuing. The more recent work reflects a more sophisticated understanding of the

12 Findings from this experiment using ''active badges' and video technology are still being processed.

13 Another example is Root, (1988: 25-39) who describes a system, labelled CRUISER, that allowed users to "cruise" the halls and offices of a building, in an attempt to simulate the experience of physically moving around a work place

14 Recollecting some of the problems with a very different system, the Cognoter, mentioned earlier.

nature of human face-to-face interaction. This analysis provides an account of how new technologies can subtlely interfere with peoples sense-making strategies (Heath & Luff: 1991). Despite the poor response to some early collaborative video experiments, the likelihood of successful applications of video has increased as more developed theories that provide rich descriptions of how people interact are incorporated in the design process.

5. Conceptions of CSCW as a Discipline

The more innovative systems, shared editors, design tools, systems that transform the social space of work have not yet reached outside the research domain. There are a number of reasons as to why this may be the case. One is that the technology is too alien for the 'everyday user' - for want of a better phrase - who is more attuned to the typewriter than the videowindow; another is that the interface to the system requires learning new skills or strategies, which are resisted because the perceived benefits are not sufficient: third, such technology may simply be too expensive. But in any case, most are a long way from being saleable, intended simply to illustrate some specific issues, techniques and ideas, and in other cases being highly elaborate, attempts as it were, to integrate a variety of technologies in new ways. And this, we think, says something about the maturity of CSCW as a discipline. For many of these systems are at once try-outs of technological innovation and testings of partly formed notions of how various kinds of collaboration can be supported. This is not to be critical of CSCW designers here, but suggesting that they may have only just begun to learn what CSCW involves in terms of new mixes of technology, and new understandings of the ways people work. The more innovative systems are first stabs at various aspects of the problem.

They are first stabs in the sense that, as yet, there is still no concensus over how CSCW systems should be designed or over how one should analyse and understand cooperation in work settings. Should we test ideas and systems out in the research labs or venture into other organisations and find out what role CSCW might have there? What does it mean to "rediscover the basic sociality of work"? (Suchman:1989). Questions like these will need to be answered before one could say that CSCW was a discipline.

Becoming a discipline will not be easy. One would have to have some idea of what the object of study is, what constitutes the problem situation. The disparity between those who see CSCW as being about group technology and those who see CSCW as about the nature of cooperative work forms in modern industrial society and how they can be supported is obviously quite large. Mixing disciplines like sociology with computer science may lead to confusions about language, goals, methods of explanation, and more. A systems designer who spends a long time studying a client organisation before starting his or her designs is not doing the same thing as an ethnographer of organisational life, for instance. Each has specific concerns and issues to think about, and each is trained by reference to distinct bodies of work. Sociological descriptions of work are not necessarily suitable for the specification of systems to support that work, and so on. Nor is this simply a problem of terminology - it represents a different set of concerns, a different perspective on what is the object of the analysis or design.

To our mind, many participants in CSCW seem to seriously underestimate the problems involved in making CSCW an identifiable research area. The issue is not, say, a matter of coming to some agreement over definitions. The ongoing debate about whether we should use, say, the term communication rather than other terms like cooperation, collaboration or coordination when discussing the field is not the crucial issue as we see it. This and similar debates are interesting, to be sure, but we believe they appeal more to the kinds of practices of a theoretical and discursive discipline like sociology than to CSCW. For if CSCW is to become a discipline then it will be one that consists of showing ways of learning to build systems that support various divisions of labour in new ways and not about *theorising the social organisation of work*. What is needed are not prescriptions about, say, which definitions are right or wrong, which pieces or "methods" should be taken from which discipline, as reflections, acccounts of how teams of individuals, from various disciplines, have worked together on CSCW projects. This will begin to provide some knowledge about what CSCW is as a craft, not an assemblage of hopes, partisan views and promisory notes. A craft in the sense that CSCW needs to embody a set of skills enabling designers to recognise the specific features of collaboration in any context, and which results in systems that reflect what is

needed. To date there are few reports on these topics [15]. Doubtless, with time, more will appear.

[15] Although some work on the practicalities of CSCW research in organistions is beginning to appear eg. Benson et al, 1990: 119-131 Carter & Harper, 1991.

REFERENCES IN THE TEXT

(ALL PAPERS REFERENCED OR CITED ARE AVAILABLE AT EUROPARC)

Bannon, L. (1988) CSCW: What does it mean? (Panel Session) In **Proceedings of CSCW '88,** Portland, Oregon, pp 189-190.

Bannon, L. & Schmidt, K. (1990) CSCW: Four Characters in Search of a Context. To appear in J. Bowers & S. Benford (Eds.) **Studies in Computer Supported Cooperative Work: Theory, Practice and Design** (Elsevier North-Holland: Amsterdam). Also (1989) **Proceedings of EC-CSCW,** London, pp 358-372.

Bannon, L. & Schmidt, K. (undated) **Computer-Supported Cooperative Work: What's in a Name?** (paper under review for ACM Transactions on Information Systems).

Benson,I and Ciborra,C. (1990) Some social and economic consequences of groupware for flightcrew. **Proceedings of CSCW '90.** Los Angeles, CA, pp 119 -130**.**

Bikson, T.B. (Moderator) (1988) Communication, and Group performance. Panel discussion, **Proceedings of CSCW '88.** Portland, Oregon.

Bly, S. (1988) A Use of Drawing Surfaces in Different Collaborative Settings. **Proceedings of CSCW '88**, Portland, Oregon. pp 250-257.

Bowers, J. & Churcher, J. (1988) Local and global structuring of computer mediated communication: Developing linguistic perspectives on CSCW in COSMOS. In **Proceedings of CSCW '88,** Portland, Oregon, pp 125-140.

Bullen, C. & Bennett, J. (1990a) Groupware in practice: An interpretation of work experience. **CISR Working Paper No. 205,** MIT Center for Information Systems Research, Cambridge MA 02139, March.

Bullen, C. & Bennett, J. (1990b) Learning from user experience with groupware. In **Proceedings of CSCW '90,** Los Angeles, CA, pp 291-302.

Ellis, C., Gibbs, S. J., Rein, G.L. (1988) Groupware: The Research and Development Issues. **MCC Technical Report Number STP-414-88**.

Ehrlich, S. (1987) Strategies for encouraging successful adoption of office communication systems. **ACM Transactions on Office Information Systems,** 5, pp 340-357.

Fish, R.S. Kraut, R. Chalfonte, B.L. (1990) The VideoWindow System and informal communication. **Proceedings of CSCW '90**, Los Angeles, CA, pp 1-13.

Grantham, C.E., and Carasik, R.P. (1988) **The Phenomenology of Computer Supported Co-operative work**. Interpersonal Software, Berkeley, CA.

Goodman, G and Abel, M. (1986) Collaboration Research in SCL. **Proceedings of CSCW '86**, Portland, Oregon, pp 246-253.

(undated) **Communication and Collaboration: facilitating cooperative work through communication.**

Grudin, J. (1988) Why CSCW applications fail: Problems in the design and evaluation of organizational interfaces. **Proceedings of CSCW '88**. Portland, Oregon, pp. 85-93.

(undated). **CSCW: The Convergence of Two Development Contexts**. Manuscript.

Heath,C. and Luff, P. (1991) **Disembodied Conduct: Communication through Video in a Multi-Media office Environment.** Paper to be presented at CHI '91. New Orleans.

Johnson, B., Weaver, G., Olson, M., & Dunham, R. (1988) Using a computer-based tool to support collaboration: A field experiment. In **Proceedings of CSCW '86**, Austin, Texas, pp.343-352.

Kraemer, K and King, J. (1986) Computer-Based Systems for Group Decision Support: Status and Problems in Development. **Proceedings of CSCW '86**, Austin, Texas, pp. 353-375.

Kraut, R. (1990). How can we make groupware practical? **CHI 90 Panel.**

Mackay, W. (1990) **Users and Customizable Software: A Co-Adaptive Phenomenon**. Unpublished Doctoral dissertation, Sloan School of Management, MIT.

Malone, T. W., Grant, K. R., Lai, K.-Y., Rao, R., and Rosenblitt, D. (1987) Semistructured messages are surprisingly useful for computer-supported coordination. **ACM Transactions on Office Information Systems**. 5, 2, April, pp. 115-131.

Olson, M.H. and Bly, S. (1991) The Portland Experience: A Report on a Distributed Research Group. Forthcoming in the **International Journal of Man-Machine Systems.**

Robinson, (1989) Double level languages and Co-operative working. **Proceedings of the conference on Support, Society and Culture, Mutual uses of Cybernetics and Science,** March 27-April 1, Amsterdam, pp 79-114.

Root, R.W. (1988) Design of A Multi-media Vehicle for Social Browsing. **Proceedings of CSCSW '88**, Portland, Oregon, pp 25-39.

Stefik,M.and Brown, J.Seely, (1987) **Toward Portable Ideas**. Xerox Corporation, Palo Alto, CA.

Stefik, M., Bobrow, D. G., Foster, G., Lanning, S., and Tatar, D. (1987) WYSIWIS revised: Early experiences with multiuser interfaces. **ACM Transactions on Office Information Systems,** 5, No. 2, April, pp. 147-167.

Stefik, M., Foster, G., Bobrow, D., Kahn, K., Lanning, S., Suchman, L. (1987) Beyond the chalkboard: Computer support for collaboration and problem solving in meetings. **Communications of the ACM.** 30, 1, January, pp. 32-47.

Suchman,L. (1987) **Plans and Situated Actions. The problem of human machine communication.** Cambridge University press.

(1989) Keynote address, **EC-CSCW '90**, London.

Tatar, D. (in press) Design for conversation: Lessons from Cognoter. To appear in **International Journal of Man-Machine Studies**.

Winograd, T. (1986) A language/action perspective on the design of cooperative work. **Proceedings of CSCW '86.** Austin, Texas, pp. 203-220.

Suggestions for Further Reading

CSCW related articles have appeared in "ACM OIS", "Computer Surveys", "HCI", "BIT", "Office, Technology and People". A CSCW Journal is about to be launched. Proceedings for all the conferences are available. In addition the following texts have appeared that are worth looking in to.

J. Bowers & S. Benford (eds), (1991) **Studies in Computer Supported Cooperative Work: Theory, Practice and Design** (Elsevier North-Holland: Amsterdam). (Collection of papers from CSCW-89 together with editorial commentary).

Gallagher, J., Kraut, R.E., and Egido, C. (eds) (1990) **Intellectual Teamwork: Social and Technological Foundations of Cooperative Work**. New Jersey, Lawrence Erlbaum Associates.

Greif, I., (ed). (1988) **Computer-Supported Cooperative Work: A Book of Readings**, Morgan Kaufman, San Mateo, California, 1988. (Collection of papers from CSCW 86 with other papers of interest).

Wilson, P. (1990) **Introducing Computer Supported Cooperative Work.** CCTA Publications. (Overview of most of the field and remarks about commercial possibilities).

Lyytine, K. (1990) **Computer Supported Cooperative Work - Issues and Challenges: a Structuration Analysis.** Department of Computer Scince, University of Jyvaskyla, Finland, Manuscript. (An extensive literature review).