CHAPTER 21

Computer-Mediated Communication

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I noted in Chapter 19 that the focus of human–computer interaction tends to be restricted to the relationship between the individual user and the computer and I discussed a broader perspective on the field that would take into account the social context in which people use computers. In this chapter I expand on how the computer can augment our current communication facilities.

> *This approach is to be distinguished from another usage of the term "improved communication facilities" in the context of human–computer interaction, where the focus is on such features as natural language front-ends and better screen pointing devices to assist users in "communicating" with the* computer, *rather than with other* people, *which is the concern here.*

Once again, the focus is on improving the computer tools that are available for collaboration between people in an effort to exploit human

capabilities more fully. This view extends the concept of human–computer interaction to that of human–computer–human interaction—namely, a perspective where the computer serves as a mediator between people. Within this framework, the computer takes its place as another piece of interactive communications technology that can be analyzed along with other electronic media such as the radio, television, and telephone.

One of the few people who foresaw the revolutionary potential of the computer as a medium for improving idea development and group communication was Douglas Engelbart, who conceived a project entitled "Augmenting the Human Intellect" at Stanford Research Institute in the 1960s. (See Bannon, 1985, for further discussion of Engelbart's work and other issues raised in this chapter.) His goal was to provide " a way of life in an integrated domain where hunches, cut-and-try, intangibles, and the human feel for a situation usefully coexist with powerful concepts, streamlined terminology and notation, sophisticated methods, and high-powered electronic aids" (Engelbart, 1962). Engelbart wanted to build a new kind of computerized working environment in which the emphasis was on how people could achieve significant gains in productivity as a result of the computerized support made available to them. Integral to Engelbart's scheme was the provision of computerized support to enhance communication between people. He wished to provide a complete new environment for "knowledge workers," an information space through which the worker navigates, and in which the worker can become totally "at home." This scenario is distinct from the more common perspective that attempts to provide the worker with a set of isolated computer tools. Having people work and live in this environment would, in Engelbart's view, ultimately lead to new insights by users of his system into the nature of problems and the evolution of a more capable society to deal with these problems.

One clear separation between Engelbart's viewpoint and that of many others working in the computing field was that he sought to develop a synergy between the computer and the human, a situation where, through the use of sophisticated tools, the human could gain new insight into problems. This was in contrast to many other system designers who focused more on the total automation of many human tasks. Another feature was that, although Engelbart's approach was criticized for a certain naivety concerning the difficulties involved in changing traditional modes of human behavior, he was aware of the need to look at a complete system—people working with computers in an organizational environment—in order to understand how technical developments might be used.

EXISTING SUPPORT FOR COMPUTER-MEDIATED COMMUNICATION

This section reviews existing support for collaboration activities, providing a rough taxonomy of the different kinds of support. It includes excerpts from responses to a query I had posted on several electronic networks concerning computer communication. I do not attempt to give a comprehensive survey of all systems available, but rather I show the range of computing facilities that can be used to facilitate person-to-person interaction and collaboration. In later sections I analyze some of the strengths and weaknesses of these facilities and relate them to different social situations.

Computer as Shared Facility

Simply having a computer system around, where people can prepare their papers and store their data, can increase collaboration. One person put it this way:

> Although we have only a few general-use data bases in the customary sense, there is a considerable amount of data-sharing in many forms—made practicably possible only by our super-mini-based computer system. And, programming packages for various applications (e.g., signal processing) often get developed for and by one group, then are applied by many of the others. Proposals and papers, more commonly than not, are prepared jointly with multiple versions of drafts being revised and edited back and forth between the various researchers in different fields. . . . people from a variety of different disciplines that, only a few years ago wouldn't have thought about sharing data or working cooperatively are, in fact, doing that now. This occurs despite the fact that we have only a rudimentary electronic mail system, and none of the nifty tools that supposedly provide for handy electronic interaction.

Electronic Mail Within and Across Systems

Many computer systems now have some form of "electronic mail" or computer messaging facility. All such systems allow people to send

textual messages[1] via computer to another person on that system, or group of people, where the message is placed in a "mailbox" until it is read by the recipient. Obvious advantages of this medium over the physical mail system are the rapid delivery of the message, the ease of sending to groups of people, and the ease of editing and reviewing stored messages. Another reason for the popularity of such systems in both research and business operations is that there is no need for the recipient to be physically contactable at the time the message is sent, as there is if one wishes to establish a phone connection. Eliminating the game of "telephone tag" is often put forward as a key office productivity gain with electronic mail systems. Most of the systems allow for files to be included in messages, thus allowing several people to work on a paper, albeit clumsily, by passing mail back and forth.

Electronic mail really becomes interesting when it is not confined to mail between people on a single machine, but when it is possible to interconnect to other computers via computer networks, both local-area networks (LANs) and wide-area networks (WANs), some of them nation-wide and even world-wide, such as ARPANET, BITNET, USENET, MAILNET, etc. These national networks allow one to make contact via computer with a much wider circle of people than was possible previously. One person put it this way describing how important the ARPANET was in the development of the Ada language:

> Not only were the design and review processes mediated by the ARPANET, but the language design team was geographically distributed. Jean Ichbiah and several others in France, a group of key people in England, the administrative work and design of a test compiler in Minnesota, and several other key people in the United States, Germany, the Netherlands, etc.

Shared File System

Shared files are very useful in collaborative work, as they allow people to access and develop their work using the same set of files without having to coordinate the transfer of files or to use complex file transfer protocols. Safeguards to ensure that people are not updating the file simultaneously must be provided. An example:

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[1] Systems are also available that support the delivery of spoken messages, for example the IBM Speech Filing System (Gould & Boies, 1983). Research is also underway to transmit voice and image information over long-haul networks.

> When I was at Xerox, we used electronic mail and shared electronic filing to great advantage—long-distance cooperation on documents was the rule, since about 2/3 of our people were in El Segundo and most of the rest in Palo Alto. I wrote a couple of papers this way, with coauthors down south; Star's Functional Description was maintained similarly . . . . The general approach was to keep the text in a public spot; give one author at a time the write access (often, divvy it up and let different folks be working on different parts. The "write access" was by consensus, rather than adjusting privileges—the privilege structure certainly would have supported it, but for papers we didn't bother. For code, it was another matter—that got formally checked out and back in again.) We'd comment and revise via electronic mail, with occasional check-ins where people got a new consistent version.

Computer Conferencing

The term computer conferencing is commonly used to refer to computer systems that provide extended facilities for keeping a record or transcript of all messages related to a topic, allowing one to set-up conferences and to browse through the topics and messages for each conference. There are usually facilities to send public and private messages, and to find out information on the conference participants. The use of the term "conference" is a bit misleading, as usually we refer to conferences as being in real-time, where all the participants are active at the same time. Although some of the systems provide a simultaneous or "real-time" mode, this is generally a less-used aspect of these computer conferencing systems.[2]

Computer "conferences" have the advantage that people can respond to topics in their own time and at whatever length they feel is appropriate rather than feeling pressured to "get in their say" before a regular meeting finishes. The quality of the conference is not determined by

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[2] There are a number of well-known conferencing systems available, including the New Jersey Institute of Technology's EIES (Electronic Information Exchange System), designed principally by Turoff; the University of Michigan's CONFER system, developed by Parnes, the Institute for the Futures FORUM and PLANET system—marketed commercially now as the NOTEPAD system by Infomedia, Inc.—developed by Vallee, Johansen and others, and the Swedish COM and PortaCOM systems, developed by Palme and colleagues.

the ease of use or power of the technology, although that can play a minor role. More important is the quality of the participants and of the appointed moderator of the conference. It is the latter's task to ensure that the meeting stays on topic and to nudge people in the right directions without making their presence too visible or interrupting the flow of ideas. The technology of itself does not guarantee anything—the quality of the conference depends on how social roles get defined in conjunction with the technology. All of these systems have been the subject of testing and evaluations by various means—on- and off-line questionnaires given to the participants, analyses of usage statistics of the system, and participant observation (see Kerr & Hiltz, 1982, for a summary of these evaluations).

Terminal-to-Terminal Communication

Many systems have some simple means of "writing" or "sending" a note in "real-time" to another terminal—often used for short messages such as "want to go to dinner now?" They are generally not used for sustained discussion as the pressure of thinking "online" can be onerous and people get tired of typing conversational-style text; they would prefer to use the telephone. Early examples of such features include the TENEX Link facility that allows up to four people to be linked simultaneously, and the CDC Plato TALKOMATIC program that segments the screen into five windows, allowing up to five anonymous users to communicate, each in their separate, scrollable, window.

Another reason that people do not carry on any sort of sustained dialogue this way is because on some of these systems—TENEX **Link** and UNIX **write**, for example—the message on the screen can become garbled if the respondent starts to type as the initiator is still typing. A convention, or protocol, has to be established in order to cue the respondent when one has finished typing. Here, the opportunities for interruption are nonexistent. Some systems, e.g., the **talk** command in Berkeley UNIX, and Plato's TALKOMATIC, split the screen and allow simultaneous noninterfering typing, which makes for a significant difference in the perceived utility of the system, but only talking is allowed: You can't get access to another person's files, or see their screens, etc. One thing to note is how apparently minor changes to the system can significantly affect the utility of the system in the eyes of the user. Buxton (Chapter 15) notes how minor changes in the control mechanisms of input devices can significantly shift the complexity of certain operations. Engelbart, in reflecting on lessons learned from the development of the NLS system, has also commented on how important "lots of little things" are to the overall effectiveness of the system.

At quite a different level, the social utility of a **write** feature can be significantly affected by the social norms existing in the organization as to its use. I know of one case where the facility, although available, was rarely used, and discovered the reason behind this was not because of its ineffectiveness, but because an administrative person had strongly hinted that people did not like to have their screens messed up by people using the facility, and so it should not be used except in dire emergencies. Not surprisingly, the facility was therefore not used very much.

> *This example, although amusing, points out a standard trade-off. The* **talk** *facility is obtrusive, it can interrupt one's current activity unexpectedly, disturbing concentration. Alternative implementations of the facility might reserve a special screen area for such conversations that would reduce the scale of the interruption, although responding to the* **talk** *request necessarily entails a switching of attention away from the current task. There remains the issue of the subtleties available within a medium to express shades of meaning—the binary choice of having the message facility activated or not on your terminal does not come close to the subtle messages that it is possible to give in an office environment through varying the position of one's office door.*

Shared Screen Facilities

A powerful tool is a facility that allows one to link to another terminal in "real-time" and actually see what is on the other's screen.[3] There are several variants of the simple shared-screen capability. Some systems allow control to be passed back and forth between the participants, some allow more than two people to participate, some provide a chat facility together with the shared screen, some allow for access to files and programs from the remote terminal, etc. These facilities come close to implementing a comprehensive shared workspace for participants, where people can point to things, edit, and run programs jointly, in real-time, as discussed by Thompson (1984). Adding in an acoustic link could significantly enhance the utility of such features, as typing

[3] Several systems provide a version of such a facility: the ADVISE command on several DEC systems; TERMTALK on the CDC Plato system; CONFERENCE on the TYMSHARE AUGMENT office system (the descendant of NLS); CVIEW on IBM machines.

speed is a limiting factor in "real-time" terminal communications. The power of such facilities might be best demonstrated by the following example:

> We have a junior programmer working on the project I am "leading" (the programmer is located 2,000 miles away from the project leader who is reporting this incident!). We are working on a Tenex-like system. I wanted to find out how things were progressing . . . so instead of calling on the phone I found her on the system and linked to her. It came out that there was a problem with a piece of code she was working on. It was giving an error message that a certain record wasn't in the database, even though it was. She couldn't find anyone in the office who could tell her how to figure out what was wrong (it wasn't the obvious things). So I converted the link into an ADVISE link. (. . . Tenex ADVISE puts the "advisor" into a state where his keyboard input is put into the input stream of the advisee, as well as the shared output function of LINK.) Then I told her (via comment command) to show me the right source things. She jumped to the right code on the screen and I then gave some more commands to jump around to other procedures being called, etc. Didn't find anything obviously wrong. So I told her to get the thing running under our debugger and put a breakpoint at a certain place and do whatever it was you do to get that code to be executed. So she loaded the program and activated the debugger and went into the program and gave a command which resulted in the breakpoint being hit. Then I started giving debugging commands and scouted around in the executable image and eventually displayed the filename associated with a certain "statement identifier" (never mind what that is). As soon as I did that she said (typed) "Oh, I know, . . ." etc. And also that she didn't understand some of the debugger commands I gave. So I told her what I had done and why. And now she knows what needs to be fixed. . . and we broke off with gossip, goodbyes, etc.

With the capabilities of bit-mapped displays today, even further sophistication in workspace sharing is possible. Rather than a simple duplication of the bit stream to two terminals, possibilities for having only parts of the displays being shared are possible, allowing individual users to keep control of various parts of their screens.

Related Media

The computer can be used as the sole medium of communication, as in a computer conference between participants who are physically remote from each other, or it can be used to augment regular face-to-face meetings, or meetings that rely on other technology, such as audio or video. I would like to mention briefly how computer support might assist at a regular meeting, where all the participants are physically co-present in the same location, and also link in discussion of computer-mediated communication with the larger literature on communication media before refocusing on the computer medium. Consider this scenario:

> Imagine that each person at the meeting has an unobtrusive terminal available, allowing access to personal files. A large-screen display at the front of the room is used to display material from any of the participants screens. There is also an electronic blackboard, where people can write and make diagrams that are stored for later use. There is a project meeting being held about the deadline for a new product. Tom starts the meeting, and with a few keystrokes made on the standup terminal at the front of the room brings up on his display some graphical information which he wishes to discuss with the group. It is possible for Tom to link the terminals of the other people in the room to his, but in this case, he decides it is probably better to use the large display in the front of the room as a common reference point, so he simply enters a command that projects his screen display onto the large screen. Initially Tom has control of the pointer on the display—controlled by a simple ring worn on his index finger, or by the mouse attached to his keyboard, but he can give control over the pointer to anyone in the group, either by handing over the ring, or by slaving the person's terminal to his, thus making the other person's mouse active and visible on the large screen. While Tom and Mary are discussing something on the screen, another member at the meeting, Joe, has his memory jogged by something that was said, so he starts privately to search his files for a particular item. On finding the item, he interrupts the main conversation for a minute, is given control, and displays his current screen image on the main screen for a few seconds, marking certain objects. He then reorganizes the display by shifting his image and

> reducing it, and bringing up the earlier display that Tom had been referring to so as to compare aspects of the two figures. Tom likes the comparison, makes some connecting lines between the two diagrams with his finger on the touch sensitive large screen display (he could also make these marks and notes using the mouse and keyboard), and then "freezes" the display for later use in his project. As well as having a dynamic record of the large screen display, he also has a reference to the origin of the information—a pointer to the file from which Joe brought up the new piece of information, should Tom need to go back to the source. Tom takes back control and starts to run some simulation sequences showing how various factors would be affected by changes in the due date for the new product. These sequences can be frozen, stepped back and forth, and annotated in the course of this activity.

Although aspects of this scenario are not technically feasible today, much of this capability was actually available and demonstrated on the NLS project. (See Licklider, Taylor, & Herbert, 1968, for a brief description.) Of course, there are a lot of potential problems with the scenario, not only from a technical viewpoint but from a "social engineering" viewpoint as well. For instance, how do we ensure that people are paying attention if they can be continually distracted by their terminal screens at the meeting? It would appear that new forms of coordination and a new etiquette for holding such a meeting would have to be evolved. Some of these kinds of functionalities, and perhaps more importantly, the underlying computer tools necessary to support them, are currently being developed on the Colab project at the Xerox Palo Alto Research Center (Foster, 1984).

Returning to the more usual scenario, where one or more of the meeting participants is physically separated from the other participants, then a variety of technologies—audio, video, or computer—might be used to establish a connection between the participants. There have been a large number of studies done on these different "teleconferencing" media, and a very useful summary of this work is available in Johansen, Vallee, and Spangler (1979). They note five fundamental characteristics of all of these electronic conferencing media that fundamentally affect the nature of the interaction: physical separation of participants; access to remote resources; narrow communication channels; potential for control of group interaction; and dependence on technology.

Obviously, a key factor missing in all of these mediated interactions is the sense of *social presence* (Short, Williams, & Christie, 1976) possible at a face-to-face meeting. This impoverishment can have serious consequences under conditions where participants are not well known to each other and might have very different goals and cultural backgrounds. On the positive side, teleconferencing can allow a group to include experts at remote points in their deliberations, expanding the knowledge base of the group. Again, this can lead to difficulties if the expert is perceived to be too distant in attitude from the group, and the expert can miss the context provided by the rest of the group.

ANALYSIS OF COMPUTER-MEDIATED COMMUNICATION TOOLS

Here I discuss some basic distinctions among computer-mediated communication tools and show how different tools might be matched to office functions. I finish on a speculative vein with the topic of electronic communities. One central theme that needs to be stressed is that uses of the new media evolve from the interplay of social and technical factors.

Communication or Collaboration Support?

Two trends can be noted in work on computer-mediated communication. One tends to focus on the capabilities of the technology and shows how certain features, for example computer conferencing, affect group communication patterns (Freeman, 1980; Hiltz, 1984). Another focuses on actual work situations and attempts to show how work might be accomplished more effectively through use of the new media. The latter does not focus on the effects of the medium per se, but on what aspects of the medium might be utilized to produce more effective tools for collaboration and coordination. Here the focus is not simply on establishing a communication link between people, but on augmenting the possibilities for interaction by using the computer to help coordinate activities and support joint problem-solving by providing shared workspaces and tools for annotating and writing documents. In this context, even as simple a facility as the personal electronic calendar that is selectively accessible to others can be an important tool to assist in the coordination process. These two approaches selectively illuminate issues in the field of computer-mediated communication.

Basic Distinctions

If we attempt to categorize the communication facilities available on computing systems, probably the most common distinction drawn is that between synchronous facilities, where parties are connected in "real-time," and asynchronous facilities, where there is no such requirement for parties to be simultaneously present on the system. Attempting to come up with a proper taxonomy of forms of interaction can be a futile quest, as it is possible to argue endlessly about the correct distinctions (see Bretz et al., 1976). However, most analysts accept the "real-time"/"nonreal-time" dimension as fundamental.

> *Scollon (1982) argues that the division of systems into real and nonreal time facilities may not be the critical feature for providing insight into our activities. He imports a distinction made by Erickson (1980) between* **chronos** *and* **kairos** *with respect to time-related activities.* **Chronos***-time is clock-governed time, whereas* **kairos***-time is time "geared to appropriateness." The former emphasizes independence of events, the latter, interdependence. The interesting issue is whether the property of being* **chronos***-timed or* **kairos** *-timed is inherent in the medium itself. Scollon argues that this is not so, citing how reading a book—quite definitely an asynchronous communication with respect to the communication between the reader and writer—can be viewed as being either* **chronos** *or* **kairos** *timed. He claims that some kind of real-time is inherent in each medium, while any medium can be geared to either* **chronos** *or* **kairos***. This would imply that the traditional "real-time"/"nonreal time" distinction is misleading as it emphasizes a perspective that takes technical features as the distinguishing characteristic. From a personal/social perspective, we can separate activities as being geared to* **chronos** *(the timeclock) or* **kairos** *(appropriateness), and communication technologies can assist in both kinds of activities. On one dimension, reading a book is a nonreal time activity, yet reading it for an exam tomorrow is a* **chronos** *activity, and reading it as bedtime reading is a* **kairos** *activity. Many technical facilities are focused on* **chronos***-type interactions, yet might also have aspects of relevance to* **kairos***-type interactions. Specifically, computer conferencing can be utilized very effectively to support* **kairos***-type activities, as control of when to interact and to what extent are usually up to the person, and are facilitated by aspects of this medium.*

This way of viewing new media shows that focusing on the point of view of the participant, rather than on characteristics of the technology, may lead to a better understanding of the relevant issues in computer-mediated communication.

Another key feature of communication facilities is to what extent a transcript plays a key role in the activity (see Carlstedt's message on page 32 of Bretz et al., 1976). Bulletin boards and computer conferencing systems rely heavily on the transcript, whereas for some synchronous facilities such as **talk** it plays a very fleeting role.

Asynchronous Interaction

Extensive use is already being made of available asynchronous facilities such as electronic mail and computer conferencing systems, and the benefits of being able to communicate with people separated in time and space are obvious—people can choose their own time for writing and reading messages, rather than being forced to respond instantly. Although electronic mail does in theory allow the user to respond as and when they desire, social forces push users into responding as soon as the message is received. In situations where it is known that users are on the system at least once every day, a delay of more than 12 hours in getting an answer to a message is viewed as being "bad manners." So here we have an interaction between the nature of the communication tool and expectations about how it should be used. The nature of the medium provides some constraints on its use, but other constraints are brought in from the social/work context.

Of course, one consequence of this flexibility in response is that it can be disconcerting for the initiator of a message to wait for a varying time length of anywhere from a minute to several weeks in order to obtain a response. This lag in feedback can be disruptive, especially in a group context, and individuals can become uncommunicative as a result. Such lags in response time are not possible in a face-to-face, or telephone encounter. Indeed Wilson (1985) notes how one role that had to be provided in order to ensure a successful computer conference was to designate an "absence coordinator" in order to know when people were away from their work, so as to ensure work was not held up while people awaited a reply from the absent person. Maude, Heaton, Gilbert, Wilson, and Marshall (1985) also note that "there is pressure on individuals participating to contribute some message no matter how trivial, each time they log into the system, to maintain a presence."

A problem in any computer conferencing system is how to provide the user with a means of keeping track of where they are in the various

conference groups that get spawned, what messages have been read, etc. Facilities for rapid browsing of discussions and retrieval of relevant messages are still quite primitive. Certainly, having a written record of the message traffic can be an advantage in certain instances, but it can also be inhibiting, as Johansen, Vallee, and Spangler (1979) note, especially in situations where delicate issues are being discussed. Sometimes one does not want everything "on the record." That is why most systems also provide a private message facility as well. However, if the bulk of communication switches to this mode, then some of the key aspects of the conference concept are lost.

The "signal-to-noise" ratio of the conference can be another problem. The emergence of open electronic networks has reduced the effort involved in sending messages to a large number of people, and as a consequence, many people are deluged with "junk mail." Similarly, in many computer conferences, one can page through many screenfuls of text before arriving at any substantive discussion. This is particularly true of the more open conferences. Of course, this can be controlled through limiting participation in conferences when they are organized around a specific work-related project, and through active intervention of the conference organizer to keep the discussion focused.

In discussing the EIES conferencing system, Hiltz (1984) makes an important observation that social characteristics of the group can affect the evaluation of the system. In other words, the technology is mediated by the social process and any evaluation must take this into account. For instance, the role of the conference leader was discovered to be a crucial determinant of group effectiveness (as perceived by the group members). This person is responsible for two kinds of activities: an *administrative support* role, orienting new members, etc., and a *conference management* role, getting feedback from group members about various conference arrangements, summarizing discussions, etc. Over time, the role of the leader can change, and the need for a clear "leader" may decline, with various people in the group performing different "leadership" roles as the occasion warrants.

Wilson (1985) and Maude et al., (1985) report how a joint activity—in this case, writing a paper—can be conducted solely through the computer medium. Of interest here is the observation that such an "electronic mailbox" system is seen as being especially useful in focusing members of the group on the task at hand (Maude et al., 1985). Others argue that keeping computer conferences "on track" is exactly what one does not want, as one of the advantages of the electronic medium is that multiple threads of discourse can be present in the conversations. Whether this aspect is one that should be fostered or not will be determined, to my mind, by the nature of the task one is

trying to accomplish (see Black, Levin, Mehan, & Quinn, 1983). Thus, within the computer medium, it is possible to focus discussion if required, but it also has the potential to support this "multiple thread discourse" pattern if desired, which is a feature that is virtually impossible to obtain in face-to-face interactions.

Synchronous Interaction

On systems that provide both asynchronous and synchronous facilities, the asynchronous facilities are much more heavily used (Palme, 1985). That is not too surprising in my view. A simple "talk" facility has limited usefulness, as most of the functions it serves are duplicated and improved upon by a phone connection when available. However, the more powerful synchronous linking facilities do have a special role that goes beyond simple exchanges of opinions on topics, and can be very helpful in consultation and tutorial sessions. Confirmation of this comes from several correspondents:

> The ability to link terminals seems to be of most use for remote demonstrations, instruction, or receiving expert assistance. I know of lots of people who are strongly in favor of it for these uses and I have seen it used effectively in these contexts.

> There were occasional problems, which mail and long-distance phone calls didn't really ease. Better was for one of us to log-in on the other's machine and run the offending code with the other one linked on, occasionally suggesting debugging probes to try or alternative strategies.

Being able to have a virtual "shared workspace" in which both remote parties can be active, sharing control, and commenting on their actions, approximates the feeling of collaboration that goes on when people are hunched side-by-side over a pad of paper, a blackboard, or a computer screen. The point is not that synchronous facilities will be utilized all the time but that they are invaluable at certain times.

The 'Ecological Niche' Metaphor

Each facility has an ecological "niche" in the space of system support, most of which have already been well-established and accepted by the

user community. Within the working environment, electronic mail lies between the phone call and the office memo with respect to its degree of formality. It is useful to try and keep this medium in such a position, rather than try to shift it in a more formal direction, as this would endanger the unique aspects of the medium, making it simply a substitute for the formal office memo. Brown (1983) emphasizes this point by arguing for a "de-speller" for electronic messages to prevent this gradual melding of one facility into another. One might want to argue about the seriousness of this suggestion, but it at least focuses attention on the importance of preserving the uniqueness of each medium of communication.

A key feature is how computer-mediated facilities mesh with other facilities—person-to-person meetings, phone calls, and video meetings. The outmoded view, which emphasized direct productivity gains to be obtained from substitution of personal communication, by electronic communication, has been replaced with a more realistic view that stresses how overall effectiveness can be improved by selecting the appropriate media for the activity at hand. Palme (1985) notes that on the COM computer conferencing system, only about 13% of the time users spent on COM was replacing face-to-face communication; 6% replacing mail and circulars; and 14% replacing phone calls; 65% was new communication. This kind of pattern has been observed by others as well (Kerr & Hiltz, 1982). We should be more concerned about the linking of the various technologies together to provide a coherent working environment for people than with attempting to force all communication through a single medium.

The majority of the studies mentioned above have involved groups of users taking part in quasi-experimental studies to gauge the effects of the new technologies. An alternative approach would be to take a real-world environment, for example, the office, and see how current office functions could be supported by the technologies. The purpose of the following section is to give one perspective on what the different niches might be for the available computer-communication media.

An Example—The Office Environment

In this section I sketch how computer tools might be selected in order to fit into and serve the needs of a given organization. The framework adopted here is adopted from Barns (personal communication, January 18, 1985). The basic model (shown in Table 21.1) makes a three-tier

TABLE 21.1
MATCHING COMPUTER TOOLS TO OFFICE INTERACTIONS

	Type of Interaction		
	Operational		Directional
Computer Tools	Bounded	Unbounded	
Electronic Mail	++	+	+++
Synchronous Tools	+++	+	+
Computer Conferencing	++	+++	+

taxonomy of system types—electronic mail, synchronous tools, and computer conferencing. Organizational interactions are divided into two main classes, Directional and Operational, with the latter further subdivided into Bounded and Unbounded categories. The number of + signs reflects the degree of match between tools and interaction types: +++ indicates high match; + equals low match.

Directional communications in the working environment map well onto the organization chart view of communications, which shows the lines of official authority. These communications tend to be of a directing/controlling nature, where the authority figure outlines the tasks to be done and leaves subordinates some flexibility in actually carrying out the assignment. Communications between the two levels are usually quite brief, and of a question-and-answer clarificationary nature. Operational interactions, on the other hand, are normally not shown on the organizational chart as often they do not define a specific mission with respect to the organization, but are more pertinent to the needs of individuals, often involving sharing of information with others, sometimes on a reciprocal basis. Learning to use the computer would be an example of this kind of activity. This might be supported by organized activities, such as training classes, but often here is where the pickup of information from coworkers is noted (Chapter 19).

In Directional interactions, the volume of information being transmitted is often small, even though it can be important (e.g., a message from the manager "I must have this program online by 2 PM tomorrow") and does not usually involve a lot of "learning" by the subordinates, as they are supposed to know how to perform certain tasks. In Operational interactions the amount of information is variable, and much learning may go on between individuals or groups as there may be little shared understanding initially. The further subdivision into Bounded and Unbounded contexts relates to the fact that in some cases one needs to fill in information within some framework,

whereas in the less-bounded situations one is actively seeking information but is unsure of exactly what all the relevant constraints are.

Given the taxonomy of organizational interactions and media types, how do they map on to each other? The major mappings are shown in Table 21.1. *Electronic mail* seems to be most relevant to interactions of the Directional sort as they handle small amounts of information well and users do not have much to learn in order to use the system. They can handle short question–answer interactions, if required (the "answer" or "reply" command available on many message systems supports this explicitly). They are less suited to Operational interactions, as it is hard to find out if similar questions had been asked and answered before (no historical record), and the separate spaces of mailboxes makes it hard to keep track of what might have been discussed by certain people before—as distinct from having a common database of information.

Synchronous conferencing tools seem most appropriate for bounded Operational interactions. The rapidity of exchange is fast, as one person can interrupt the other if a change in direction is required or the issue redefined. If the computer is itself being used to solve the problem posed in the interaction, then switching between the task itself and comments on the task (meta-description) are possible with minimal delays—as in face-to-face discussion. These tools are probably less good for unbounded Operational interactions as they only work well for limited contexts: They require more learning than electronic mail, and they do not support long background messages that might be required for certain interactions.

Computer conferencing tools seem well suited to unbounded Operational interactions because they have many facilities for cross-linking information, and they support enquiries that seek out background information on a topic. They are also more suited to handling large volumes of information and projects that exist over a long timespan that would be impossible with synchronous facilities. They are less suited to the other two interaction types as the overhead required for the cross-linkages is unnecessary in Directional interactions. Within a particular context, there is a danger of having much "useless" information within the conference format.

In sum, for relatively straightforward interactions electronic mail seems most appropriate. For more open, inquiring interactions, the much richer structures supported by conferencing systems seem worthwhile, even though the overhead in learning time is much greater. Further, more detailed, analyses of office interactions could provide the basis for developing aspects of this model and serve to show what kinds of system supports might be appropriate or need developing.

POSTSCRIPT—ELECTRONIC COMMUNITIES

To some analysts, new technological capabilities in the area of communications will have a profound impact on our society, creating the "Global Village" of McLuhan and the "Global Information Society" of Masuda (1982). These authors expect that the technologies will cause changes in personal and organizational work patterns. Debates on "telework" and opportunities for reductions in travel as a result of new technology often adopt this perspective. Such a position assumes that technology is the key force acting to change the nature of today's society, a position labeled *technological determinism.*

The alternative account, which I favor, places greater emphasis on the large number of factors that effect change in today's society, of which new technology is just one. The technology does not determine how society will evolve, but it does provide new possibilities. How society actually evolves will be determined by the complex interplay of social forces and technological opportunities. In the context of our current concerns with computer-mediated communication, the technology affords certain possibilities for affecting our current communication practices, and changes will occur, but they will evolve in the context of the decisions—not all of them rational—made by both individual, organizational, and societal actors. This does not thereby imply that we cannot attempt to use the technology in innovative ways, it simply warns of the limitations of Utopian thinking that is overly guided by technological possibilities.

Computer-mediated communication, in its many and varied forms, could under appropriate social conditions help to create new communities of people, bound together by a shared interest in a topic or a shared background. The grassroots development of community bulletin boards using privately owned personal computers is an example of such a nonwork-oriented community formation. Much has been made of the dangers of technology with respect to alienating individuals and reducing direct social interaction both in quality and quantity. The argument here is not to substitute for the richness inherent in face-to-face interaction, but to explore new ways and means of interaction through the computer medium as a supplement to other modes of interaction. Through international computer networks, it is possible to obtain information from a vast pool of human resources that would be difficult to tap in any other fashion.

At a more local level, many projects are concerned with providing both electronic access and production facilities for the local community. In some cases, due to time and distance constraints, face-to-face interactions may not be feasible, yet electronic interaction may still be

possible. The "Community Memory" project in Berkeley, California involves a community bulletin board that is accessible from a number of terminals distributed in shopping areas and other community meeting places in the neighborhood. It is an attempt to refashion electronically aspects of the ancient marketplace which served many functions, including that of informal meeting place—the Greek *Agora*—where the development of community is strengthened by increased interactions at all levels of intensity and duration.

Thompson (1972) notes the importance placed by Jane Jacobs on the city sidewalk as being a place where people can pick up useful information in chance encounters, and wonders what would be the electronic equivalent—some electronic means of idly browsing information spaces and coming across potentially useful information, without actually searching explicitly for that information. Again, the intent is not to simply duplicate the kind of interactions that occur on sidewalks, but to provide some features of this kind of interaction in another medium. There is, of course, a limit to this enterprise: attempting to completely substitute one medium of communication, in all its variety, for another, is not likely to be successful. Rather, we need to develop a more comprehensive understanding of each medium, of the tasks we wish to accomplish, and the best match of the two for any particular problem. In this light, electronic communities do not replace but extend the notion of work community that I discussed in Chapter 19. The fundamental insight is the shift in perspective within the field of human–machine interaction to include the potential of the computer medium to significantly enhance the possibilities for communication and collaboration among people.

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