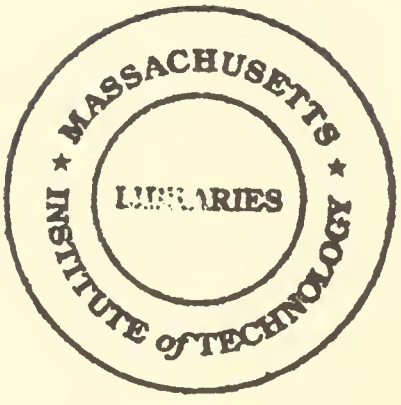
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USER APPROACHES TO COMPUTER-SUPPORTED TEAMS

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March 1987

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USER APPROACHES TO COMPUTER-SUPPORTED TEAMS

Robert Johansen

Computer-supported teams are small collaborative work groups that use specialized computer aids. Typically, these are project-oriented teams who have important tasks and tight deadlines.

The team members may be present in the same room or they may be attending an electronic meeting at which other participants are not in the same place at the same time. If team members are physically separated, they may decide to use a store-and-forward communications medium that allows them to communicate according to their own schedules. Sometimes, computer-supported teams are permanent groups; more often they are ad hoc task forces or other teams with a defined lifetime. The group interaction might be formal or informal, spontaneous or planned, structured or unstructured.

While computers have been used to support previous team efforts, the emerging concept of computer-supported teams differs from that of past computer support. Many computer systems are already used by more than one person (for example, time-share computing), but such user "groups" are simply aggregations of individuals. That is, each computer user is seen by the system as a discrete unit; there is no little or no direct interaction among the users. The software typically is designed for individual users. Computer-supported teams introduce a new dimension: software designed specifically for groups.

APPROACHES TO COMPUTER-SUPPORTED TEAMS

What could group-oriented software do to support the work of teams? This paper begins by introducing 17 approaches to team support as it is already beginning to appear. A definite overlap occurs among some of the approaches, but each has its own perspective. These 17 approaches represent a variety of possible steps toward computer-supported teams; the steps get larger (with reference to the present) as the list progresses. Each approach is described, illustrated by a brief scenario, and followed by a brief assessment of the current status of this approach and a notation of possible pitfalls.

This is an inductive approach to computer supported teams: it begins by simply describing what is going on in the user world. After this overview, I will come back to categorizing current efforts and anticipating what is likely to happen next.

1. Face-to-face Meeting Facilitation Services

Face-to-face meetings are already a way of life in business and there are people who specialize in facilitating these meetings. Typically, such facilitators work independently on a consulting basis, but large companies sometimes have in-house people who are on call to help make meetings work. Today, the normal tools of the facilitator are the flip chart pad and the felt tip pen. What if electronic support for the facilitator were available, which, in turn, could support the activities of a work team?

Scenario 1: "Chauffeur" (Support for face-to-face meetings)

> The team members are in a spirited argument as they explore their options for presenting an interim report on their work to date. This is a meeting to plan the presentation they have scheduled with their boss in two weeks, the halfway point in their task force assignment. As the team members talk with each other, a facilitator types quietly at the side, recording summary phrases from each statement that are projected on a screen for the group to see. Periodically, he stops the meeting and asks the group members to look at what he has recorded and to check it for accuracy; he then tries to organize what he is hearing into a more coherent whole. If the facilitator doesn't understand, there is little chance that the boss would understand. Some of the notes created by the facilitator look like electronic versions of what would have been written on flip chart pads. There also are brainstormed lists of ideas and graphic summaries that the facilitator thinks might work for the executive presentation. As the meeting ends, the team agrees on four alternatives for consideration. Draft versions, along with the complete meeting notes, are printed on a laser printer at the back of the room and photocopied for the team members to take with them as they leave.

CURRENT STATUS: A small company called Meeting Technologies (Berkeley, California) performs a service quite similar to the one described in the scenario using three Macintosh computers that they have connected together and some special software they have written for group recording. Several other group facilitation companies are moving in a similar direction. Also, several user organizations have constructed permanent rooms to support such facilitation activities.

POSSIBLE PITFALLS: Facilitators are not well accepted in most companies. In addition, most facilitators are not adept at computer use and the software tools for such facilitation are not yet fully developed. Conference rooms will have to be specially equipped to support such activities, or the facilitators will have to carry their equipment--like traveling rock groups.

2. Group Decision Support Systems

Decision support systems (DSS) have gradually emerged and are used heavily within many user companies. Keen and Scott Morton introduced the concept of DSS, defining it as the use of computers to: "(1) Assist managers in their decision processes in semistructured tasks; (2) Support, rather than replace, managerial judgment; (3) Improve the effectiveness of decision making, rather than its efficiency."[1] Why not extend the DSS concept into Group Decision Support Systems (GDSS)?

Scenario 2: "GDSS" (Support for face-to-face meetings)

> The team has to decide. There are seven different views among the seven team members, but they have to reach one decision. The first thing they agree upon, though not easily, is how to phrase the question, how to decide what they have to decide. Next, the GDSS asks them for anonymous judgments, it asks them about their own uncertainties, and it asks them to self-rate their expertise. After all the team members have entered their judgments, the system does some aggregation of the opinions and feeds back a first round set of judgments from the group. The group goes through a series of these "rounds" until a decision is reached. The system certainly does not make the decision, but it provides an effective and efficient group decision-making process.

CURRENT STATUS: Group decision support systems have been in use in limited ways for almost 20 years. Kraemer and King have conducted a recent survey of such systems and conclude that, in spite of years of attempts, "The field of GDSS's is at yet not well developed, even as a concept."[2] These are isolated examples, but there is little success to report.

POSSIBLE PITFALLS: Formal procedures for decision making often are frowned upon by "real business people"; significant changes in perceptions and prodedures may need to occur. Decision support tools, while plentiful for individuals, often lack the flexibility needed for group applications in business. Conference rooms may need to be adapted to allow for GDSS and this adaptation is likely to be expensive. Most companies are used to conference room expenditures that only include items like overhead and slide projectors, or (perhaps) a speakerphone--not expensive equipment.

3. Computer-based Extensions of Telephony for Use by Work Groups

The telephone is a "workstation" that is familiar to everyone. If it is possible to build from the telephone, the leap to computer-supported teams does not seem as great for prospective users. There are two basic approaches that are not necessarily exclusive. One builds on the capabilities of the telephone network itself (or private networks); the other builds on the on-premises private branch exchanges (PBXs or the smaller systems, called keysets) that are already common and are becoming powerful.

Scenario 3: "Telephone Extension" (Support for electronic meetings)

> The team meeting is booked for 2:00 p.m. and the phones ring right on time. Each team member sits at his or her desk, with a screen display that shows a virtual conference room table indicating who is present and who is talking at the given time. Each of the seven team members is acknowledged on the screen, with their voices coming through the high-quality loudspeaking telephone. When a team member has a draft or some data to show, it can also appear on the screens. To the team members, the system is an extension of their telephones, an extension that includes what they used to do on a personal computer and what they used to do through a surly conference call operator. Face-to-face meetings still occur, but the telephone meetings provide much more regular communications options.

CURRENT STATUS: Northern Telecom's Meridian already provides services very much like this scenario, including one called "Meeting Services." Meridian is a PBX that also acts for all the world like a computer. A telephone network-based product that provides some of these capabilities is the AT&T Alliance bridging service. This service now provides long distance conference calling for much of the United States through a digital bridge that also has capabilities for exchanging graphics among group members. These are both leading edge products, but I expect that they will be followed by an increasing number of group-oriented telephony products and services.

POSSIBLE PITFALLS: PBXs are just developing group support capabilities and these capabilities may be tied to expensive purchases of complete new PBX systems. This linkage to larger systems is positive in the sense that group support capabilities will be positioned as features on the new system, but it also means that it may be difficult for teams to get access to such systems without becoming involved in a larger purchase

decision. (Network-based services do not have this problem, since they can be sold as services and prices can be based on use.) Telephony-based approaches also need to be connected in some way to the computing equipment already used by teams, and this connection, in some cases, may be difficult.

4. Presentation Support Software

Team members often have to make presentations, either to the team itself or to people who have an interest in what the team is doing. Software can make the process of preparing presentations much easier, even if the meetings themselves have no new electronic aids. Instead of relying only on a graphics artist, with frequent long delays, many presentations can be prepared by the author. Professional graphics assistance can also come into play, but many uses of graphics for teams will not require such specialized skills.

Scenario 4: "Presentation Prep" (Support for face-to-face meetings)

> The team has worked over the ideas for weeks. Now it is time to do a briefing for the boss and the boss's boss. Vugraphs (overheads) are the medium of choice in this company, so the new ideas have to be boiled down into vugraphs. Each team member has played with vugraph content, formats, and styles before the meeting. After going through various drafts, they finally agree upon just the right "look" for their presentation. Then comes the final rush: as usual there are changes up to the last five minutes before the meeting. When it was over, the presentation looks great, except for the laser-printed typo in the lower right-hand corner of the concluding paragraph.

CURRENT STATUS: Presentation software is becoming more common, primarily because of the rise of "desktop publishing." Indeed, presentation software is a variant of desktop publishing. One aerospace company has developed its own software that is geared toward its own internal project briefings, with slide preparation software (for preparation and display on personal computers) and links to conference calling capabilities. Several software companies are introducing extension packages that allow output from existing software (for example, a spreadsheet or idea processor) in a form that can be used directly for presentations.

POSSIBLE PITFALLS: Such software may introduce role conflicts within an organization: presentors aren't used to creating their own visuals and graphics artists may feel left out. Role changes will need to occur, such as presentors learning enough about style and format to use the software. Graphics artists will need to learn the software and adapt their skills to those areas where a nonartist with software cannot perform well. In addition, quality control problems can arise.

5. Project Management Software

Work teams have obvious and often pressing needs for task planning and coordination. Specialized software could help them plan what needs to be done, track their progress in reaching goals, and coordinate activities under way by individual team members. The big issue with project management software is to find a system that all team members will actually use.

Scenario 5: "Team Conscience" (Support between meetings)

> The team has better things to do with its time than keep records. There is a harsh set of deadlines to remember, however. While the team focuses on the content of its work, the system has a basic record of tasks to be conducted, task assignments, subtask breakdowns, and schedules. Each team member reviews his or her progress with the system on a weekly basis; the system is used during team meetings every other week. The software has very little intelligence; it simply organizes what the team has to do and reminds the members when it has to be done. This discipline and resulting coordination is probably more important than the actual functions performed by the software.

CURRENT STATUS: Project management software is becoming increasingly common in the personal computer arena and increasingly good as well. Some systems even include limited artificial intelligence capabilities that allow for internal judgments about progress or lack of same.

POSSIBLE PITFALLS: Any approach to project management must be used by all key team members in order to be valuable. Project management software must be compatible enough with the styles of team members to allow this participation to occur. This will be tough for software designers, since the needs and styles of work teams will vary greatly.

6. Calendar Management for Groups

This is a straightforward approach: work teams need to coordinate calendars with each other and perhaps others. Unfortunately, implementation is not as straightforward as the concept implies. Many people are reluctant to use computer-based calendars in the first place, often with good reason. Yet anyone who has tried to schedule a meeting among several busy people will have thought: there must be a better way.

Scenario 6: "Our Black Book" (Support between meetings)

> Each team member designates times that are unavailable and available, with a weighting that indicates flexibility in the event the system has trouble finding matches of free time. At first, it is hard to get everyone to use the system. Gradually, however, the team agrees that "The Black Book" should be the calendar of last resort and that each team member has to be responsible for keeping his or her own calendar in synch. "If only it would fit in my pocket!" is the recurrent lament.

CURRENT STATUS: Electronic calendars have been accepted very slowly within most user communities, especially by those people who have secretaries or assistants who will schedule meetings for them so they can avoid the hassle. Gradually, however, calendaring systems are coming into the marketplace. On the research side, the logistics of group calendaring are becoming better understood and applications are promising.[3]

POSSIBLE PITFALLS: As with project management, group calendaring requires full participation and this will be difficult to achieve on many teams. In addition, many people are very protective of their personal calendars; these people are likely to resist the notion of an electronic calendar, especially when it is shared and--to some extent--under the control of others.

7. Group Authoring Software

Group authorship is a common practice already, typically via a series of scrawled comments that are centralized onto one draft before changes are made. Group authorship software would allow team members to make document revisions, with the system remembering who made which changes. Team members could suggest changes without wiping out the original; comparisons among alternative drafts would be allowed easily. The overall goal would be to improve the speed and quality of group writing.

Scenario 7: "Group Writing" (Support between meetings)

> The brief is being filed today in San Francisco because that is where the court is, but the principal attorneys are in New York and Washington. The first draft was done in New York and shipped electronically to Washington and San Francisco. Changes were made in all three cities; the system kept all the versions of the brief, with indications of authorship. The lead attorney made decisions to take this paragraph from Washington, this one from San Francisco, and so on. The brief is being filed on time.

CURRENT STATUS: Group authoring software has been introduced recently by at least five separate companies, all with interesting products.[4] These introductions, however, have just occurred and it is too early to see how successful they will be.

POSSIBLE PITFALLS: Group writing is a delicate process at best and working together through software could increase the difficulties for some work teams. This delicacy magnifies the problems inherent in creating group writing software. Even if the software works well, coordination of the various authors will be critical to success. Some teams may give up early because the barriers of behavior change, learning, and coordination are too imposing.

8. Computer-supported Face-to-face Meetings

In this case, the team members work directly with computers, rather than through a "chauffeur" (as in approach 1 above). This is a bigger step, of course. There is a requirement for more than one workstation in the room, for software that can provide direct group support, and for enough user skills to make it possible. It builds, however, on the familiar notion of face-to-face meetings. As Mark Stefik, developer of the most advanced system of this type states, the primary competition is the white board.

Scenario 8: "Beyond the White Board" (Support for face-to-face meetings)

> Each team member had been working on a section of the final report. They walk into the specially equipped room with diskettes in hand (although one person has managed to send his files through the company's local area network from his desktop workstation to the conference room). The half-circle table includes six personal computers connected together and a display screen. Team members work privately during the meeting or display their work for others to see. In the meeting, they work through each section of the final report, doing revisions on the fly. When they leave the room, they leave with a common "group memory" of what has occurred and which next steps will occur next.

CURRENT STATUS: The COLAB at Xerox Palo Alto Research Center (PARC) is already beyond this scenario, though only for a single user group. It is based in the Intelligent Systems Laboratory at PARC and is designed for a high-level team of artificial intelligence researchers.[5] Several commercial attempts to develop more limited systems have met with little commercial success.[6] Research experience, however, is yielding significant insights that can contribute to future products.

POSSIBLE PITFALLS: The technology for acting out this scenario is almost here, but it is difficult and expensive to assemble. Integration of the hardware components is also tricky and the software, in most cases, is only available in upstream R&D settings. The issue mentioned in Scenario 2 regarding the reluctance of companies to spend money on equipment for conference rooms is also a pitfall.

9. Personal Computer Screen-sharing Software

If one person can make good use of a personal computer and that person is also involved in team efforts, wouldn't it be useful for that person to be able to "share screens" with other team members? This approach to computer-supported teams builds directly on personal computer use: anything that can be displayed on a personal computer screen could be shared with another (and perhaps more than one other) personal computer screen.

Scenario 9: "Screen Sharing" (Support for electronic meetings)

> "I think we should move this circle over here and turn the arrow in this direction . . ." He talks as he moves the circle and redraws the arrow on his PC, but the other team members see it change on their PCs as he does it. They are also connected by conference call to discuss the revisions. They are in a "scratchpad" version of the program right now, but the system keeps track of the drafts and of who creates what. At the end of the meeting, everyone has revised versions on their own PCs.

CURRENT STATUS: Various attempts to create personal computer software for screen sharing have been made over the past several years. So far, none has been a commercial success. There seem to be at least two problems: first, it is tricky for users to get the logistics down (to be sure you have the right diskette in the right drive, the right modem settings, and so on). Second, while the idea of screen sharing is immediately attractive to many PC users, it also requires some behavior change. Are there really that many times when you want to share a screen while you talk with someone? I suspect that we will see an era of computer-supported teams, but that some changes in ways of thinking will be necessary first. Screen-sharing software is increasing gradually in popularity, but rapid growth does not seem likely. Screen sharing for specialized teams, such as architects or engineers doing computer-assisted design, seems to be the most likely early applications area.

POSSIBLE PITFALLS: Screen sharing is one of those ideas that looks great in principal but that has sticky problems at the implementation stage. As indicated above, the logistics of multiple users and multiple screens can be very difficult for both system designers and users.

10. Computer Conferencing Software

Computer conferencing provides group communication through computers. It is the group version of electronic mail. Electronic mail systems are designed for person-to-person communications; filing of messages is by the individual. Computer conferencing systems are geared toward groups; filing of messages is by group or by topic. Computer conferencing is a logical step toward computer-supported teams: once communications take place through a computer, other forms of computer aids should be easy to provide.

Scenario 10: "Invisible College" (Support for electronic meetings)

> The team is close: they work together each day and often some work of them into the night. The six team members are based in three countries and two states within one of the countries. The "time window" when they are all in their offices at is very short. Thus, they usually work in a store-and-forward mode. They check the team's conference twice per day, see what has happened since they were there last, make their own comments, and leave. Drafts and other working documents, graphics, or models are also exchanged through the conferencing system.

CURRENT STATUS: Computer conferencing has been possible technically since about 1970, but few organizations have really taken advantages of its potential. Commercial systems are currently available, but none is doing very well. Several private in-house systems, however, are very successful. It has proved very difficult to get people used to computer conferencing as a general purpose medium of communication.[7]

POSSIBLE PITFALLS: Computer conferencing appears to present more organizational than technical problems. In cases where it has not worked, it typically has been introduced by a forward thinking management information system (MIS) person who realizes quickly that such capabilities have more to do with a way of organizing work than they have with a computer system. Computer conferencing can easily create new channels of communication that might be quite different from the organizational chart. MIS people, of course, typically have little training in organizational change and that responsibility is certainly not part of their jobs. Thus, computer conferencing often is dropped after a triol, without ever achieving a "critical mass" of users within a com-

pany. Small teams can use computer conferencing without organizational support from their companies, but they must go through independent service providers to do so. (Indeed, small teams are the major clients of such services.) Most teams simply do not know such options exist, or they find them too hard to organize.

11. Text-filtering Software

Work teams often have needs for large amounts of information that is often hard to find. Text filtering allows users to search free-form or semistructured text, with more power achievable through more structure. Typically, users specify search criteria to be used by the filter. Text filtering can also be used to identify people with common interests. In this way, text filtering can be used for computer support of much larger communities.

Scenario 11: "Needle in a Haystack" (Support for electronic meetings)

> The team uses the filter to search out information and people that will help move its task forward. As is typical with many work teams, the members are working in a field that is still not mapped or well understood; they are ahead of the key words in traditional databases. The filter helps them specify just what kinds of information they want. Each morning, the filter prints a personalized "newspaper" for each team member, showing items from the preceding days news, as well as new findings from the ongoing search for leads. Person-to-person messages also are filtered to insulate the team members from low-priority interruptions.

CURRENT STATUS: Text filtering is being pursued most comprehensively by Tom Malone at MIT.[8] The original title of his experimental system was "electronic mail filter" and it was intended to help users prioritize their incoming messages. Now his focus has broadened to an "information lens" orientation, whereby the system reaches out to find information that matches the rules created by each user. Commercial systems for text filtering have not yet begun to appear, but there are definite indications of interest from both users and potential providers.

POSSIBLE PITFALLS: Text filtering is still more of a vision than a reality. While the research is very encouraging, it is still mostly research. The most promising short-run possibilities require much prestructuring of input from users; prestructuring means behavior changes in order to meet the requirements of the system. Possible requirements for such behavior changes are pitfalls to consider if teams pursue text filtering now, instead of waiting for future improvements in capabilities.

12. Computer-supported Audio or Video Teleconferences

Another approach to computer-supported teams is to start with users who are already familiar with audio or video teleconferencing. If they see merit in teleconferencing, it is likely that they will be open-minded about the potential for computer support for the electronic meetings they already hold.

Scenario 12: "Teleconference Assistant" (Support for electronic meetings)

> The regular Friday teleconference has just begun and the budget glares back at the team members from the projection screen, with task overruns flashing in red. Each of the two video rooms has four team members present, all of whom are staring at the screens. "What do we do now? We've still got our deadline, but we don't have any money!"
>
> The discussion centers on this question, with periodic recalculations and searches of parallel budgets to come up with additional funds. At the end of the meeting, the numbers are "frozen" for the team members to take along on paper copies. They have to keep working; next week they'll decide who will pay for it.

CURRENT STATUS: Computer use within teleconferences has been very low to date. One computer manufacturer, however, uses projections of computer output during audio conferences in a fashion very similar to the scenario above. Also, several video teleconference rooms include personal computers on an experimental basis.

POSSIBLE PITFALLS: Video teleconferencing still is not a usual mode of business behavior. Adding computer support can serve to further increase the sense of technological discomfort felt by many users. For audio conferencing, the pitfalls can be similar to those noted in Scenario 9 for screen sharing.

13. Conversational Structuring

Communication among team members is a critical aspect of a team's performance, even though it is rare that much thought is given as to how to structure this communication most effectively. One approach to computer-supported teams is to develop (or select) a structure for team conversations that will be in close keeping with the task and style of the team participants themselves. Structured conversations might provide both increased efficiency and effectiveness, if done well.

Scenario 13: "Say What You Mean" (Support between meetings)

"OK, lets do it."

WHO SHOULD DO WHAT?

"I guess I should get it going."

WHAT WILL YOU DO, BY WHEN?

"I'll do it by Friday."

I'LL PUT IT ON YOUR CALENDAR AND ADVISE THE REST OF THE TEAM. WHAT, EXACTLY, ARE YOU AGREEING TO DO?

CURRENT STATUS: Conversational structuring is quite a different approach to software. It requires building explicit forms of communication about what most teams usually do in unstructured ways. The first commercial software to take a signficant step toward conversational structuring is The Coordinator (by Action Technology of Emeryville, California).[9] I expect to see others within the next couple of years.

POSSIBLE PITFALLS: Structuring people's conversations is risky business. It can be perceived as intrusive or worse. Careful thought must be given to what forms of structures make the most sense for a given team, as well as how to introduce the structures once they have been selected.

14. Group Memory Management

Work teams have an obvious need for a "group memory", particularly if individual members can search the memory in the ways they prefer (search methods are likely to vary among team members). The problems arise in structuring data so that it can be retrieved as information by team members. Very flexible indexing structures are needed if this to happen. The term "hypertext" has been used to describe nonlinear indexing structures that allow very flexible storage and retrieval options.

Scenario 14: "Picking Up the Fishnet" (Support between meetings)

> "I remember it was an idea we had a couple of months ago. I think it was Fred, and it had something to do with the notion of "frequency"". Sara fumes in frustration as she tries to remember the idea.
>
> The Team Memory system contains notes from all the team meetings, with links among many of the words and concepts. Sara follows a weaving and bobbing path through words, data, and people in search of the lost idea. When she finally finds the idea, it isn't nearly as good as she had remembered it. However, the search process triggers a new idea for her, one that is much better than the original one.

CURRENT STATUS: The term "hypertext" was coined by Ted Nelson in the early 1970s, but it is only now making its way into regular (though certainly not yet common) usage. At this writing Xerox's NoteCards system is one of the best examples of hypertext. It is structured around the idea of working on index cards that can be linked and cross-referenced very easily.[10] Also, a hypertext system for the Macintosh has just been introduced (Guide, developed by Owl Systems International of Seattle) and I expect more such systems over the next several years. Hypertext systems have great potential for computer-supported teams.

POSSIBLE PITFALLS: Hypertext is only now becoming understood and operationalized. Today's systems may be difficult for some teams to access, or difficult for them to use even if they can get to them. Also, this approach to indexing requires the creation of a new "infrastructure" for at least some aspects of team interaction: it will sometimes take major commitments at the front end in order to create the type of group memory that will prove useful down the line.

15. Computer-supported Spontaneous Interaction

It is often said that the most important team meetings happen around coffee pots or in hallways. Can electronic systems be used to encourage and/or support such encounters?

Scenario 15: "Electronic Hallway" (Support between meetings)

> It is almost midnight when Betsy is ready to log off the system. Just then, the system notifies her that Karen has logged on. They type to each other briefly before shifting to an audio link. (Neither of them is interested in a video link at midnight.) A long conversation ensues, the kind that rarely occurs at the office while everyone is rushing about.

CURRENT STATUS: Gordon Thompson was one of the first to discuss the "electronic hallway" idea and its potential for influencing the formation and operation of groups.[11] The closest manifestation is the System Concepts Laboratory (SCL) at Xerox PARC. SCL is looking out five to ten years to explore computer-supported group technology and practice. Half the lab is physically located in Palo Alto and half is in Portland. Audio, video, and data links are available between the two groups 24 hours a day. They are emphasizing informal collaborative work for groups of two to ten people. The current system allows "drop-in" encounters over electronic media, much like what currently happens in hallways or around coffee pots.[12] Such communication is very important for teams and it certainly occurs much more frequently than formal meetings in conference rooms.

POSSIBLE PITFALLS: The major hurdles here are logistical: how, specifically, do you go about creating an "electronic hallway"? Today's systems simply aren't that portable or that flexible. Thus, the major pitfall can come from expecting too much too soon from this approach. In the long run, there is real promise, but this is a long run approach.

16. Comprehensive Work Team Support

Work teams have many support needs and, toward the ambitious end of the spectrum, an integrated computer-based system is certainly attractive. Of course, comprehensive support is difficult to provide, even if the focus is on only one type of team. Still, this is an important direction that is becoming feasible.

Scenario 16: "It's All Here" (Support between meetings)

> The competition is two weeks into a new advertising campaign that is particularly threatening to the brand team. The latest data are now in and it is time to figure out what they mean. Each team member takes a crack at the analysis, sending along draft spreadsheet models and statistical passes through the new data. Finally, they meet around a workstation, with one person doing the updates and final runs.
>
> A summary briefing is then prepared for the brand manager, who receives the briefing and background data on her workstation ten minutes before the meeting at which she is to decide how to respond to the competition.

CURRENT STATUS: The vision of comprehensive team support was first proposed by Douglas Engelbart in the early 1960s.[13] Engelbart built a prototype system, NLS, that still serves both as a benchmark and a high water mark. Movement from vision to commercial reality has been slow, however. (A commercial version of NLS is still available from McDonnel Douglas as AUGMENT.) The most significant step to date is focusing on brand teams in packaged goods industries, much like the scenario above. Metaphor Computer Systems (Mountain View, California) has an integrated system targeted specifically toward these types of high performance teams. At this point, it seems reasonable to conclude that comprehensive team support can be provided best if it is geared toward specific types of teams, as with Metaphor.

POSSIBLE PITFALLS: Users are likely to find that the specific funtionality they achieve within an integrated system is not as powerful as that same functionality in a stand-alone system. This presents a trade-off between the values of integration and power within specific functional areas. In addition to this trade-off, integrated systems are also likely to be expensive and probably are not compatible with the mainstream software marketplace.

17. Nonhuman "Participants" in Team Meetings

At some point, computer programs should be able to function, in some sense, as team "members." This is the most ambitious approach to computer-supported groups in the list of 17 and it relies heavily on developments in artificial intelligence.

Scenario 17: "Nonhuman Participants" (Support for electronic meetings)

> The team meeting for new brokers is just convening. Each trainee has spent the better part of the preceding day working with the Coach, an expert system that has specialized expertise about investment options that the new brokers will be selling in another three weeks.
>
> There ore many opinions; even the Coach is only expressing an opinion. The new team discusses the options, consulting again with the Coach at several points during the meeting. The Coach has specialized knowledge that nobody on the team has, but it does not have definitive answers. It is a collaborative process, with all the team members (including the Coach) contributing.

CURRENT STATUS: There are no real examples of a computer program functioning as a team member, although there are several examples in user organizations (all in confidential settings) where similar ideas are being pursued. More detailed scenarios exist that introduce the concept and explore some of its implications.[14] There is also a growing interest among artificial intelligence researchers in the role of expert systems as a "knowledge medium," whereby people communicate through an expert system, rather than simply extracting information from it as an autonomous system.[15]

POSSIBLE PITFALLS: Designing systems that are thought of as people (or team "participants') may be quite misleading and perhaps counterproductive. Today's state of the art means that systems are a long way from personhood; this may always be so, or at least it is likely to be so for a long time to come. Care must be taken that the "nonhuman participant" is not oversold or misunderstood by human team members. In short, expectations must be managed within the realm of realism.

UNDERSTANDING WHAT IS GOING ON

What patterns can be seen across these 17 approaches to computer-supported teams? These approaches obviously cover a wide range of user activities. While it is too early to conduct a detailed analysis of what is going on, it is useful to try out various categorizations of the current activities. First, Table 1 presents all 17 approaches in a single table, arranged in approximate order of increasing difficulty.

Looking across the user approaches summarized in Table 1, it is possible to do a number of different groupings. Having tried several, I find it most useful to categorize the approaches according to one of the fundamentals of any work team, the meeting. I use a broad definition of "meeting" here, including any form of group interaction. The 17 approaches to computer-supported teams can be classified in the following fashion: support for face-to-face meetings, support for electronic meetings, and support between meetings. Table 2 presents this grouping.

Table I

17 User Approaches to Computer-supported Teams

1. Face-to-face meeting facilitation services . . . "Chauffeur"
2. Group decision support systems . . . "GDSS"
3. Computer-based extensions of the telephone for use by work groups . . . "Telephony for Teams"
4. Presentation support software . . . "Presentation Prep"
5. Project management software . . . "Team Conscience"
6. Calendar management for groups . . . "Our Black Book"
7. Group authoring software . . . "Group Writing"
8. Computer-supported face-to-face meetings . . . "Beyond the White Board"
9. Personal computer screen-sharing software . . . "Screen Sharing"
10. Computer-conferencing software . . . "Invisible College"
11. Text-filtering software . . . "Needle in a Haystack"
12. Computer-supported audio or video teleconferences . . . "Teleconference Assistant"
13. Conversational structuring . . . "Say What You Mean"
14. Group memory management . . . "Picking up the Fishnet"
15. Computer-supported spontaneous interaction . . . "Electronic Hallway"
16. Comprehensive work team support . . . "It's All Here"
17. Nonhuman Participants in a Team Meeting . . . "Nonhuman Participants"

Table 2

. Categorizing the 17 Approaches to Computer-supported Teams

Support for face-to-face meetings

Scenario 1:	"Chauffeur" (facilitation services)
Scenario 2:	"GDSS" (group decision support)
Scenario 4:	"Presentation Prep" (presentation support software)
Scenario 8:	"Beyond the White Board" (computer-supported meetings)

Support for electronic meetings

Scenario 3:	"Telephony for Teams" (extensions of the telephone)
Scenario 9:	"Screen Sharing" (personal computer software)
Scenario 10:	"Invisible College" (computer conferencing)
Scenario 11:	"Needle in a Haystack" (text filtering)
Scenario 12:	"Teleconference Assistant" (for audio or video teleconferencing)
Scenario 17:	"Nonhuman Participants" (on-line resources)

Support between meetings

Scenario 5:	"Team Conscience" (project management software)
Scenario 6:	"Our Black Book" (calendar management software)
Scenario 7:	"Group Writing" (software)
Scenario 13:	"Say What You Mean" (conversational structuring)
Scenario 14:	"Picking Up the Fishnet" (text filtering)
Scenario 15:	"Electronic Hallway" (spontaneous interaction)
Scenario 16:	"It's All Here" (comprehensive support systems)

Of course, some of the scenarios could fall under more than one heading in Table 2. Scenario 13 (Conversational Structuring), for example, could fit under any of the three headings: support for face-to-face meetings, electronic meetings, or between meetings. I put it in the last category because I feel that is where it focuses from a user point of view. That is, conversational restructuring can help a team keep itself organized and on track with a structure that moves beyond specific team meetings.

Table 2 suggests that most of today's approaches to computer-supported groups are focused on electronic meeting support and support between meetings. These approaches also tend toward the middle and upper end of the difficulty spectrum (as indicated by scenario numbers, 1 through 17). Two of the options for face-to-face support are at the "easy" end of the spectrum (face-to-face facilitation and group decision support), as are one for electronic meeting support (building on the telephone) and three for support between meetings (calendar and project management, as well as group writing).

Classifying approaches to computer-supported teams according to support for team meetings is, of course, only one possibility. Others to consider (all of which are beyond the scope of this paper) are the type of support provided, the size of the group to be supported (in this paper, I have considered only small work teams), or the type of group to be supported. The purpose in this paper is simply to introduce the concept of computer-supported teams and to begin a consideration of how the concept might develop in the future.

FORCES FOR COMPUTER-SUPPORTED TEAMS

The 17 approaches to computer-supported teams indicate an energy around this general concept, even though the concept obviously is not focused. Several forces in the business world are helping to generate this energy for computer-supported teams.

First, and probably most important, is the general trend toward business teams. Teams have become the order of the day for many large companies. Cross-organizational groups are most common: project teams or task forces that have important mandates and tight time deadlines. These groups are searching for tools that will help them get their jobs done. Computer support often seems to provide an answer, or at least part of an answer. Most business teams also have access to funding for such computer tools, should they prove useful. In addition, a purchase by a business team will be evaluated by different criteria than a purchase from a data processing, MIS, or telecommunications manager. Where operational people typically are worried about saving money, business teams often are focusing on ways to make money. Consequently, they often will be more willing to try something new and to take promising risks.

As a side benefit, the performance of business teams is more often tractable than the performance of large organizations. If a team has a clear task and a time-table, its productivity should be measurable, or at least more measurable than many parts of a business. This measurability of effects should make business teams even more attractive to executives. Also, if business teams use computer support effectively, the success stories should be convincing indeed.

The only downside from the business teams phenomenon comes from possible excesses. It is easy to imagine situations in which so many team meetings take place that little real business gets done. Business teams have to be used selectively in high-leverage areas in order to be effective.

Second, but still very important, is the acceptance by most businesses that computers can be used to gain competitive advantages. This notion has been promoted by the good business schools for over five years, but now it is finally having an effect on the masses of U.S. business people. Because of this realization, there should be more receptivity toward the idea of computer-supported teams.

Third, the penetration of personal computers has now grown to the point where interconnection of team members at their desks is usually practical. The evolution of business-oriented software supports this trend. Those PCs sitting on desks, even if they are not being used, represent potential building blocks for equipping computer-supported teams. Many business people also seem to have a sense that their companies might have moved to quickly in the race from the mainframe to the isolated desktop. Users often realize that they want their PCs to be linked at least to the PCs of their closest coworkers.

Finally, the personal computer industry is expressing strong interest in group-oriented software. While much of this interest is within R&D organizations of large computer manufacturers rather than product planners, software developers also express strong interest. One driver for them, of course, is the search for the "next 1-2-3," the next software bonanza that will spur sales (and use) of personal computers. The climate in the personal computer industry is becoming more favorable for the growth of group-oriented software.

BARRIERS TO COMPUTER-SUPPORTED TEAMS

Until this point in this paper, I have emphasized the promises of computer-supported teams. But, there are barriers to consider, also. The most basic problem is typical of emerging technologies: "it" (computer-supported teams) is very hard to name and describe organization/technology quickly to newcomers. Notice the format of this paper. I went through many drafts trying to come up with a crisp leading definition. Finally, I resorted to leading with examples of computer-supported groups rather than definitions.

As a researcher who has worked often with emerging technologies, I have come to realize that the problem of names is recurring. By definition, an emerging technology is hard to name. If it has a good name, it will not be emerging, it will have emerged. When an emerging technology has a "grabber" name, its emergence will come much more quickly.

This "unnamability" is tough on prospective users of computer-supported teams. New ideas are alot easier to grasp if they have easy "handles" that can be used to describe them. In the case of computer-supported teams, the handles are pretty awkward. Here are nine competing terms that mean about the same thing as (or at least overlap considerably with) what I have called "computer-supported teams":

-- "Technological support for work group collaboration"

-- "Computer-supported cooperative work"

-- "Collaborative systems"

-- "Workgroup computing"

-- "Group decision support systems (GDSS)"

-- "Interpersonal computing"

-- "Departmental computing"

-- "Augmented knowledge workshops"

-- "CAC (Computer-assisted communications)"

These are not names that will stir the hearts of the business people.

Unless prospective users can think of a better name, I would advise a "Trojan Horse" approach wherever possible. Do not bill this as something new. Bill it as a

way to get done whatever a particular team has to get done. This approach may be best in the long run as well, since it is not clear that the range of approaches I have grouped under the heading of computer-supported teams will remain part of an integrated field of activity. As usual with emerging technologies, the early stages involve much uncertainty.

The second barrier to computer-supported groups is even more down to earth: group-oriented software is not easy to develop. Most of the problems are nitty-gritty, rather than state-of-the-art technological, but they are problems nonetheless.[16] Thus, the growth of group-oriented software will be tempered by the difficulties of creating this software. The transition from individual to group software is a major transition and software designers will have much to learn in the new world of group support.

Third, there are few success stories to date regarding computer-supported teams. The 17 approaches described earlier in this paper provide a good taste for the present range of experience, but user experience is limited. Most of the approaches are not well tested by users. Furthermore, there are incentives not to exchange success stories with other users when they do occur. Because work teams often are working on important tasks, sensitivities crop up regarding competitive advantage. Many of the user examples I gathered in researching this paper were described to me under nondisclosure.

Finally, product groups in the major computer manufacturers (as compared to upstream R&D groups within those same companies) are not yet interested in group-oriented products. This is understandable. For most vendors, particularly in these days of short-term financial pressures, little interest exists in products that require customers to make conceptual changes. Big vendors do not make money selling conceptual change, or so the argument goes. At this point, R&D groups at major vendors are pursuing group-oriented products, but the transfer has not been made to the product planners. This transfer will occur, but how long will it take?

A FORECAST

In conclusion, I will venture to forecast how computer-supported teams are likely to develop over the next few years. My estimate is that group-oriented software and systems will be rare for the next three years, followed by a period of rapid growth in the three to five year time frame. The barriers above are too imposing to expect

rapid growth in the near term, even though the forces for computer-supported teams will win out in the long run.

In the meantime, I expect that innovative user organizations will see the three to five year "delay" as a "window of opportunity" for them to gain competitive advantages through the use of computer-supported teams. In particular, I expect that user organizations with the following characteristics will be major users of computer-supported teams in the near future:

-- Companies with many decentralized project teams

-- Companies with a high penetration of PCs and local area networks

-- Companies with successful teleconferencing systems

-- Companies that are known for their flexible organizational structures

-- Companies with a track record for early adoption of information systems innovations.

In this three to five year time frame, I also expect that small software companies will be active. These will be high-risk ventures, however, since they will be leading the behavior change efforts implied by group-oriented software. Small service providers should be quite successful, since it will be feasible for them to package some of the benefits of computer-supported teams and to sell them as a service to users who do not want to undergo major development efforts themselves. The major manufacturers are not likely to take the lead; they will wait for the acceptance of group-oriented software. The major software providers have real opportunities in the short run, but they are most likely to let the small companies do the software R&D and "test marketing" for them. The successful small providers of group-oriented software will then become acquisition candidates.

In short, group-oriented software will happen in a big way. The only question is when. For the next three years, expect big wins by only a few players--innovative users, service providers, and a few small software companies. In the three to five year time frame, computer support for work teams will become much more accessible and much more heavily used.

FOOTNOTES

[1] Peter G.W. Keen and Michael S. Scott Morton, Decision Support Systems, Reading, Massachusetts: Addison-Wesley, 1978.

[2] Kenneth L. Kraemer and John Leslie King, "Computer-Based Systems for Cooperative Work and Group Decisionmaking: Status of Use and Problems in Development," in Proceedings of the Conference on Computer-Supported Cooperative Work, December 3-5, 1986, pages 353-375.

[3] For an example of research on group calendaring, see Irene Greif and Sunil Sarin, "Data Sharing in Group Work," in Proceedings of the Conference on Computer-Supported Cooperative Work, op. cit., pages 175-183.

[4] For an overview of four current products, see Richard Dalton, "Group-Writing Tools: Four That Connect," Information Week, March 9, 1987.

[5] For a basic description of COLAB, see Mark Stefik, Gregg Foster, Daniel G. Bobrow, Kenneth Kahn, Stan Lanning, and Lucy Suchman, "Beyond the Chalkboard," Communications of the ACM, January, 1987.)

[6] Several of the commercial and research efforts are described in Kraemer and King, op. cit.

[7] For a broad vision of what computer conferencing might do, see Murray Turoff and Roxanne Hiltz, The Network Nation, Reading, Massachusetts: Addison Wesley, 1978. For a comparison of early social evaluations of computer conferencing, both pro and con, see Robert Johansen, Jacques Vallee, and Kathleen Vian, Electronic Meetings, Reading, Massachusetts: Addison Wesley, 1979.

[8] For a basic description of this work, see Thomas W. Malone, Kenneth R. Grant, Franklyn A. Turbak, Stephen A. Brobst, and Michael D. Cohen, "Intelligent Information Sharing Systems", Communications of the ACM (in press).

[9] A summary of the approach embodied in the Coordinator is contained in Fernando Flores and Chauncey Bell, "A New Understanding of Managerial Work Improves System Design," Computer Technology Review, Fall, 1984. For more detail on the conceptual underpinnings, see Terry Winograd and Fernando Flores, Understanding Computers and Congition, Norwood, New Jersey: Ablex Publishing Corporation, 1986.

[10] For a concise summary of NoteCards, see Frank G. Halasy, Thomas P. Moran, and Randall H. Trigg, "NoteCards in a Nutshell," Xerox Palo Alto Research Center, Submitted to CHI+GI 1987, Toronto, Canada, April 5-9, 1987.

[11] Gordon B. Thompson, "An Assessment Methodology for Evaluating Communications Innovations," IEEE Transactions on Communications, Vol. COM-23, no. 10, October, 1975, page 1048.)

[12] For a summary of the SCL activities, see George Goodman and Mark Abel, "Collaboration Research in SCL," in Proceedings of the Conference on Computer-Supported Cooperative Work. pages 246-252.

[13] The now classic statement of Engelbart's vision is contained in D. C. Englebart, "A Conceptual Framework for the Augmentation of Man's Intellect," in Howerton and Weeks (editors), Vistas in Information Handling, Washington, D.C.: Spartan Books, 1963.

[14] The notion of a nonhuman participant in electronic meetings is described in some detail in scenarios included in Robert Johansen, Teleconferencing and Beyond, New York: McGraw-Hill, 1984, pages 131-165.)

[15] See Mark Stefik, "The Next Knowledge Medium", AI Magazine, Volume 7, Number 1, Spring, 1986.)

[16] For a description of some of these problems, see Irene Greif and Sunil Sarin, op. cit.