VII.B. Conferencing via Computer: Cost Effective Communication for the Era of Forced Choice

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Introduction

To keep our high-technology, fast-changing, urbanized society going, new ways are needed to share information, solve problems, anticipate the future decide, and manage. "Business as usual" in these respects seems likely to become even less acceptable than at present in an era of scarce human and physical resources and inflationary cost increases. We are entering an Era of Forced Choice.

For some time the available ways of pooling information, planning, and determining what had to be done next have been ill-fitted to the problems and the pace of change. Much of this increasingly unmanageable change was triggered by earlier decisions based on inadequate information, too limited assumptions, and too little anticipation of consequences. Thus the energy "crisis" turns out to be the forerunner of a probably chronic condition: resource shortages and/or unacceptable costs requiring fundamental changes in many of the ways we work and live. These ways have been built on the assumption that fuel for heating, cooling, and moving people would continue to be plentiful and cheap. Now the shortfall in petroleum seems only one symptom and consequence of a much more fundamental shortcoming: the lack of ways for preventing possible alternatives from becoming forced choices.

Reexamining trade-offs between transportation and communication is one kind of reassessment which is now unavoidable. For examples, nowadays more is heard of substituting telecommunications for work-related travel: the kinds of things that have to be communicated about require improved ways of linking people, and costs of moving people from place to place are becoming more and more burdensome. Choice of communications over transport, it would seem, will be more and more necessary. Innovations that can make communication a preferable alternative to transportation are especially needed. Some such technologies, and the new ways of behaving they encourage, are just now emerging.

One of these is conferencing via computer. As a way of linking people and organizations for many purposes, computer conferencing promises more effective use of energy and resources for many group tasks, especially those previously assumed to require that participants be in each other's presence at the same time (and therefore with a need to travel to the same location). In the Era of Forced Choice, such assumptions will be increasingly questioned. Innovations that offer a better way, not just a second-best alternative, will be especially significant. Conferencing via computer shows all the signs of being one such innovation.

This brief discussion is to describe how conferencing via computer works, how it might be applied more widely, and why it is a significant innovation for an era in which new and better ways of problem-solving and managing are being forced upon us.

What Is Computer Conferencing?

Conferencing via computer is a readily available, but as yet little publicized and not widely tested, medium for communications and problem-solving. It consists of linkages between individuals who "connect" by each conferee having available a remote terminal (a keyboard with letters, numbers, and symbols linked to the control computer) plus a cathode ray tube (CRT) display device and/or a printer. The central computer is programmed to sort, store, and transmit each conferee's messages. The individuals linked in this way may interact at the same time, or, more typically, at their convenience, with the computer holding all messages until accessed.

Linkage via computer provides significant advantages for conducting many kinds of information exchange and problem-solving, as compared with other media (face-to-face meetings, mail, conference telephone, closed-circuit television). It also calls for new ways of behaving, and creates some problems for those unaccustomed to the fast and complex information flow that computer conferencing encourages. Among these new conditions are the relative novelty of communicating via a keyboard and mastering a set of conventions for operating such systems. These can be surmounted with practice. More subtle, and of greater significance, is the degree to which conferencing via computer will offer more cost/effective, more flexible, and informationally richer alternatives for managing and problem-solving in groups and organizations-if those who try it can permit themselves to abandon some more traditional communications habits.

The following discussion of several versions of computer conferencing emphasizes very recent developments that have not yet been reported in the small body of professional literature on this subject. Most of the information came from personal and telephone interviews with some of the principal innovators and practitioners of computer conferencing, plus a review of existing literature both on computer conferencing and on relevant discussions of social technology and organizational behavior. (The literature on computer conferencing per se is not large, and new developments are considerably ahead of publications on the subject.)

Because developments in this field are occurring very rapidly, with a number of different groups exploring the technique with various goals or emphases, there is substantial disagreement among the various practitioners on what should be considered "true" computer conferencing. One view is that conferencing via computer is a new primary communications technology, like the teletype or the telephone, offering the possibility of many new kinds of communicative behavior, as well as virtually infinite potential for supplanting or supplementing other media [35, 39]. Another view is that computer conferencing capability is but one example of a large family of tools for "dialogue support" to facilitate connectedness between "knowledge workers" [9-12].

Computer conferencing is seemingly only a small part of the field of computer networking and time-sharing, even though all time-shared systems principle could offer the person-to-person interactive feature (direct communication between those accessing the network). But computer time-sharing developments have emphasized person-machine interfaces: that is, most attention has been paid to how the operator interacts with the computer, making inputs and getting outputs from the computer's models and

data bases [42]. Relatively little attention has been devoted to how the computer could be used for *throughput,* establishing links between individuals, between an individual and a group, or between groups. It becomes evident that different ways of structuring these communications are appropriate to various kinds of intellectual- or managerial tasks. Use of the techniques of conferencing via computer forces explicit consideration of how the interaction should be managed and in what ways the participants should interact. These implications of computer conferencing as a technique or communications medium require separate consideration from classical time-sharing applications of computers (the transfer or melding of data, without the aspect of mutually influential interaction between *persons).*

The use of the computer for conferencing makes the computer a true communications medium, supplementing its use as a medium for storage and computation. Because of the features of storage, retrieval, and data processing, not available through other media, computer conferencing is a significant advance over other communications media. According to criteria for a true communications medium stated by Gordon Thompson [35], computer conferencing:

?? offers an easier and more flexible way to access and exchange human experience
?? increases (virtually to infinity) the size of the common "information space" that can be shared by communicants (and provides a wider range of strategies for communicants to interrupt and augment each other's contributions)
?? raises the probability of discovering and developing latent consensus. (The enriched information base and heightened interconnectedness increases the chances that each conferee can receive unexpected and/or interesting messages.)

These are the principal 'versions of computer conferencing now in use or being developed:

?? Civilian (nondefense, nonaerospace) agencies of the federal government, mostly through the now disbanded Office of Emergency Preparedness in the Executive Office of the President, have used links via computer to carry on information exchange and coordination activities in a number of situations requiring rapid information flow and collaboration [38, 39]. In this case, computer programs for conferencing developed from a need for better communications for crisis-management. The simplest version, PARTY LINE, operates with participants involved simultaneously, the equivalent in electronic data processing technology of a conference telephone call. PARTY LINE has the added advantage that a full record of the inputs by each participant is preserved. An elaborated version of this computer program, EMISARI, makes it possible for specialized forms of information to be included, such as tables, bulletin-board items, and special computations. EMISARI also includes participation by a conference monitor who directs attention to key issues, guides discussion, and "brokers" between different interests of participants. This feature takes account of various roles participants

may play, as in any conferencing situation [28]. Some will be *stakeholders,* with an interest in or responsibility for decision-making. Others may be *experts,* with relevant knowledge that needs to be accessed or revised. Still others, including the monitor, may be *process specialists,* whose concern is to enrich the total information base or level of collaboration. All such roles are played in effective face-to-face conferencing; EMISARI and other computer conferencing require that these roles be played more explicitly, leading to more effective results from the total exchange. Participants can interact at times of their own convenience over hours, days or weeks, and messages can be retrieved, edited or rearranged by the conference monitor or other participants. In short, the EMISARI monitor - borrowing from Delphi studies techniques (see below)-interfaces between the system and the users, and wires them up as needed. The computer becomes in effect a huge blackboard capable of handling different types of messages. Development of these systems is principally the work of Dr. Murray Turoff, now in the Computer Sciences Department at the New Jersey Institute of Technology, where he is continuing design, development, and testing of computer conferencing programs, as well as evaluating effectiveness of their use for a variety of purposes.

?? At the University of Illinois (Champaign-Urbana), Stuart Umpleby and his co-workers have devised the DISCUSS conferencing program. DISCUSS operates on the PLATO system, originally a device for computer-assisted instruction developed by Dr. Donald Bitzer. DISCUSS augments PLATO by adding conferencing features. This new development is being continued with support from the National Science Foundation. The PLATO system uses a plasma tube to display messages, which can be in the form of graphics as well as alphanumeric symbols, and can access text files as well as other stored data [45].

?? The Institute for the Future (IFF) in Menlo Park, California, is the center for a long-range program to develop computer-conferencing techniques. IFF also has received a grant from the National Science Foundation to study the effects of conferencing via computer on the attitudes and behavior of users of the system. This work evolved from a search for improved ways of conducting Delphi studies: the systematic interrogation of experts in forecasting, and pooling of their judgments. Drs. Robert Johansen, Richard Miller, Hubert Lipinski, and Jacques Vallee are tied to the network linking researchers who participate in the work of the federal Advanced Research Projects Agency (ARPANET). Through this computer network the IFF program is able to tap into data files elsewhere by the use of codes punched into the remote terminals, and to combine these data sources and computational capabilities for problem-solving as well as information exchange [23]

?? At Northwestern University, the Computer Aids to Teaching Project in the School of Education is building a computerized learning exchange linking students, teachers, and researchers with a program called ORACLE. The basic premise of this system came from seeing education not as programmed instruction, but as a process of communication. This combines the conferencing feature with computer-assisted instruction (a program called HYPERTUTOR), access to information files, and computational capability. The total system consists of some thirty terminals on the Evanston and Chicago campuses, about 15 of which are used for CAI and

conferencing. Dr. James Schuyler reports that software has just been inserted in the system that will give reliable and comprehensive cost data on system performance. The Northwestern group also participates in conferencing the PLATO system centered at the University of Illinois [33].

A commercial application of conferencing is the MAILBOX program developed by Scientific Time Sharing Corporation (STSC), Bethesda [2,6]. STSC started in 1969 and in early 1974 had about eighty employees. These individuals are at about two dozen locations; the sales offices are in twenty other cities; about half the people are at the Bethesda headquarters. MAILBOX links all of these individuals at whatever location and the several hundred customers of the firm. Common data that can be accessed by any number of users is stored on IBM 370/158 computers in Bethesda. MAILBOX is used for technical discussions as well as exchange of information with customers. Customers may also, by subscribing to the time-sharing service, use MAILBOX for communicating with each other and with STSC, under controlled-access conditions permitting any degree of confidentiality desired. STSC also has a parallel program-NEWS-designed for information exchange only; in effect, a computerized news service capable of being "customized" in a variety of ways.

?? Bell Northern Research, a part of the Bell Telephone Company in Canada, is another center for research and product/service development in computer conferencing. Gordon Thompson of Bell Northern is exploring ways to turn the conferencing feature into a generalized information utility. Also under development at Bell Canada is a linkage of participants in a telephone conference call to a multitrack tape recorder, so that asynchronous conferencing could be done by telephone. As with printout or CRT, callers will be able to send and receive messages encoded to specific individuals or to the conference at large, by using touch-tone codes [36]. Use of voice links will circumvent the main present barrier to widespread computer conferencing the inability or disinclination to type in a remote terminal (or use a secretary as an intermediary) [33].

?? The Augmented Knowledge Workshop at Stanford Research Institute [10], headed by Douglas Englebart, has been in existence for more than a decade and is an important parallel development to -computer conferencing systems. Inventions by the SRI Workshop potentially could augment computer conferencing by enriching the information environment through CRT display of data files, linkage of conferees via TV, and text editing using a computer storage and three-dimensional displays of data. The SRI Workshop is mainly devoted to increasing the richness of face-to-face interactions between conferees. Now these techniques could be grafted to programs that permit interaction between conferees at a distance from each other. The SRI group is building from this a "computer utility for knowledge workers," primarily in business and industrial organizations, who as subscribers can make use of the special facilities developed in the Augmented Knowledge Workshop. Some twenty organizations have already subscribed to this service [12].

Costs and Benefits, Financial and Otherwise

According to Turoff [40], there are five situations in which conducting a conference via computer is better than the alternatives:

- ?? when the individuals needing to contribute knowledge to the examination of a complex problem have no history of adequate communication, and the communication process must be structured to ensure understanding;
- ?? when the problem is so broad that more individuals are needed than can meaningfully interact in a face-to-face exchange;
- ?? when disagreements among individuals are so severe that the communication process must be refereed;
- ?? when time is scarce and/or geographic distances are large, inhibiting frequent group meetings; and/or
- ?? when a supplemental group communication process is needed.

The most significant feature of all of these versions of computer conferencing is that they have developed in response to communications challenges for which conventional media, were either inadequate or did not occur until the computer conferencing mode became available. In no sense do the systems so far developed represent unproven or experimental uses of available hardware or software. They are well within the state of the art of computer equipment and programming capabilities. But flexible and fluent use of computer conferencing is an art, as are other communication forms. The limitations of the method are determined more by the skills of users than by the capacity of the technology. The problem, as Englebart has said, is how to apply and customize the service to particular uses, and for users to develop facility in using such systems so that the conferencing mode melds well with other kinds of communications and facilitates work, rather than representing merely an exotic use of computers to be pursued for its own sake [l2].

A frequent comment regarding new media is that each new medium offers problems without really compensating advantages. Estimates of the value of a medium of communication (both in terms of effectiveness and in terms of cost savings or other benefits) must be in terms referring to how the system is to be used and what the insertion of the medium into a situation does to other variables in that situation [7]. Thus for computer conferencing it is not enough to compute the financial costs of the technology itself in comparison with other technologies. Attention must also be given to what the use of the medium costs and what it gains-in terms of user time and productivity, effectiveness of communication, etc.-in comparison with other modes.

Some financial data compiled by Turoff are a good starting point. He estimates [44] that the installation costs of a remote terminal are now in the neighborhood of $2,000 using a cathode ray tube (CRT) display, or about $3,000 with the capability of producing hard copy. These costs are declining rapidly, and by 1980 can be expected to be equivalent to the present cost of a large color television set. Thus, basic equipment for computer conferencing capability is well within the reach now for even fairly small organizations using time-sharing computer services, and is still easier for those medium

and large organizations that have their own computers. (There are approximately 300, 000 to 500,000 terminals now in .use, and about forty manufacturers of terminals.)

The use of computer time (for processing of messages in the computer), another cost element, is minimal even for fairly continuous conferencing. Scientific Time Sharing Corporation, which owns its own computer, estimates that the cost per message in central-computer-processing-plus-telephone-circuit time is somewhere between twenty-five cents and fifty cents, which is far cheaper than long-distance telephone and is competitive with mail when typing time and postage are considered. An added saving comes from the fact that the same message can be communicated to a large number of people at no significant extra cost per recipient [6].

There are these additional data available on costs:

Published commercial rates for timesharing costs of a Univac 1108 gives an upper limit of 19 cents per second for central processing time, $5 for an hour of terminal time, and $1.20 a month for 10,000 characters in storage. [One conference] conducted over 13 weeks used approximately an hour of central processing time, 100 hours of terminal time, and less than 100,000 characters in storage. If we assume an hour of thinking time for every hour on the terminal, 25 days of effort were donated, which is a minimum of eight consulting trips, not counting travel and per diem costs, telephone, and clerical processing costs in the conventional mode [48].

Other analyses by Turoff show that, when the value of the time of participants is taken into account, the savings of computer conferencing over face-to-face meetings become dramatic. Cost comparisons should be made in terms of communication effectiveness for various media per dollar invested in communications. For example, effectiveness can be defined as the ratio of (1) amount of information exchanged face-to-face to (2) amount of information shared using the computer as a medium. Turoff assumed a cost of computer time of seven dollars per hour per participant. If the number of participants is more than a dozen, and the value of the time of each participant is even as low as five dollars per hour, his analysis showed that conferencing via computer was no more costly than: (1) a meeting requiring travel, (2) a meeting with all participants at the same location, or even (3) a conference telephone call. Of course, computer conferencing becomes far more cost/effective when any of the following increase: value of individual participant's time, conference duration, or number of participants.

Thus, cost of hardware and computer time aside, computer conferencing in some circumstances can result in considerable savings of staff time as well as greater use of information and ideas potentially available. Some of the ways in which this works are illustrated from this account of an experience of the computer conferencing group at the Institute for the Future:

> We had come back to the office from a large-scale test of our conferencing system. The test had involved twelve terminals and there were many difficulties. To get all the points considered and to begin to solve the problems that had been identified, the four of us who had been at the test first went to remote terminals and had a teleconference with each other. We just went to the terminals and poured out all our ideas and observations. There was no waiting for ".`air time" (as would be the case in a face-to-face meeting). After about an hour of that we had ten or twelve pages of printout.

> Then we proceeded to sort out the ideas. After an hour or two we had an ordered array of all the topics to be discussed and all the decisions that had to be made. Then we needed a blackboard; the teleconferencing broke down. But normally these steps would have taken a full day. Instead, it took a total of about two hours, but we did need both media.
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> ... We had discussed what needed to be done while on the way back from the test, and in that preliminary discussion we thought we had much the same information and reactions. But in putting all our thoughts on the terminal we found that each one of us had forgotten certain aspects, and some points were clearer than others. Looking at the printout we had a much fuller view of what had gone on in the test [23].

Origins of Computer Conferencing

In a 1968 article [25] computer conferencing was proposed as a means of speeding up the rate of interaction and the data-processing operations involved in Delphi studies. The Delphi technique is a method that has been developed to pool expert judgments while attenuating or removing some biasing effects such as the influence-of the reputation of one panelist on others. The meaning of Delphi has now, been broadened to include all forms of structured communications processes involving information exchange and the pooling of judgments [27].

The monitor of a Delphi exercise presents a series of assertions (predictions of future occurrences, normative statements regarding proposed actions, statements of intention, etc.) to the panel, which is selected for its special knowledge of the subject. The panel also may include individuals with expertise outside the field under consideration but with special-capabilities for analysis or judgment between alternatives. Panelists vote on these alternatives, return the information to the monitor, and the data are combined and arrayed, then resubmitted to the panelists individually. At this point each panelist knows the judgment of the group and can compare the distribution of group judgments with his own choices. New data (e.g., additional assertions from the monitor) may also be introduced at this point. Panelists may then modify their judgments or not, but in any case they proceed from a larger information base than in the first round. The process may continue through several rounds in the same manner.

The difficulty with the Delphi process conducted in face-to-face conferences or by mail is that the turn-around (sending and receiving mailings plus processing of the data and preparing each round for the panelists) can be very time-consuming, resulting in a loss of initiative and focus. Adding computer capability makes it possible to cut turn-around time to a minimum, thus; permitting the introduction of many more iterations` and more material per iteration:

It became clear that communication via computer could be useful for many. other kinds of geographically dispersed groups. All computer networks in principle could have interactive features akin to conferencing. That is, the operators of timesharing systems could use the system to transmit operator-to-operator messages as well as to interchange data or run routines on remote computers [20]. But the emphasis in conferencing was originally for real-time exchange of information, proposals, and instructions in situations requiring fast response time and the coordination of the efforts of many different kinds of actions at

locations widely separated geographically. Gordon Thompson observes [36] that computer conferencing works best when the problem is clear but information exchange is complex and pressured (as in coping with a geographically dispersed crisis). Such was the case in 1970 when the Office of Emergency Preparedness needed data on steel-industry capacity and production to do a rapid national assessment of the industry's performance and capabilities [40]. One outcome of this experience was the realization that the system should be automated, so that information and technical assistance could be exchanged rapidly between a large number of participants. The PARTY LINE program. evolved into EMISARI.

This augmented capability was in place at the Office of Emergency Preparedness a year later when the ninety-day wage-price freeze was announced. It was then necessary to have information rapidly from every section of the country on enforcement activities, problems and questions encountered in the ' field, rapid dissemination of decisions by the Cost of Living Council, and coordination of the Office of Emergency Preparedness headquarters efforts with those of the OEP regional offices, and with field representatives of the Internal Revenue Service, who, along with representatives detailed from other agencies, had been charged with field enforcement. Conferencing using EMISARI went on throughout the three-month period, starting with about thirty participants: (i.e., terminals; each participating terminal might serve a number of individuals at a particular location) and rising at the end to more than seventy [42].

In the OEP response to the wage-price freeze, EMISARI became in effect an electronic blackboard of unlimited size, on which any of the participants could insert data, raise queries, or request revisions. These interactions could occur at times convenient to each of the participants. When coming on-line, a participant could receive all messages held in the computer's storage and also see what had occurred throughout the information array since the last participation. This information was available on printed-out hard copy, or a CRT, display, or both.

On the "blackboard" were identifications of all the participants, their names_ and responsibilities. Associated with each of these participants were quantitative data and other messages. Those who had programmed the system were also participating. Thus the programmers could be queried directly by those in the, field who did not understand an instruction or thought that something might be incorrect about information presented. Text files could also be accessed by participants. The text files contained "bulletin board" announcements, abstracts of documents, policy decisions or directives (e.g., from the Cost of Living Council), and press releases. The total system provided a real-time monitoring and communications device with fast turn-around to track and direct the wage-price freeze on a national basis. Turoff sums up the experience [43] as follows:

> We took all the people who were gathering data regionally, those who were trying to .respond to information requests in each region, those preparing staff reports from these data, the middle management level in the agencies, and the data grubbers. They were all in contact and everyone could know what everyone else was doing. The system allowed them to pass information back and forth, and also allowed monitoring of the process and the passing on of instructions from high up,' and inputs from such groups as the Cost of Living Council, such as the type of: information the White House might want in any particular week.

Since 1971, EMISARI and its derivatives have been used for further work on economic controls, and for rapid assessment of fuel stocks and production capabilities early in the energy crisis [43]. In August of 1973, the software for conferencing aspects of EMISARI, created by Language Systems Development Corporation of Bethesda, became available as a computerized conferencing system at nominal cost through the National Technical Information Service, Department of Commerce.

At the Institute for the Future, computer conferencing began to be used as early as 1969 for the conducting of Delphi studies, of the type outlined above. IFF started with a strong bent toward classical Delphi (pooling of estimates and forecasts by experts) but moved toward less-structured versions of the technique as the use of computer conferencing permitted greater freedom. IFF also began recently a long-range research program on the behavior of users: what kinds of people and what kinds of problems prove most amenable to the computer conferencing technique, and what problems are associated with the use of the medium.

Little analyzed so far is the impact that computer conferencing can have on the style and structure of organizations that use it. For example; at Scientific Time Sharing Corporation, using MAILBOX has caused the STSC organization to be shaped by the interaction patterns that have grown up as a result of the use of the system [2]. Instead of a pyramidal form of the conventional organizational hierarchy, with specialized groups reporting and through individual line managers, the organization has taken the form of constantly changing clusters of groups or teams; each may be formed quickly for, a particular project or problem, and disband just as quickly when the issue at hand has been dealt with. There are also relatively more permanent groups, such as those concerned with continuing development of MAILBOX itself. The experience of working with MAILBOX is described as follows by Lawrence Breed, a vice president of STSC in Palo Alto, California, who has been largely responsible for developing the system:

> It has a flavor which is quite unlike any other form of communication, for example face-to-face exchange. For instance, you have whatever time is needed after receiving a message to get your own thoughts together and come back with a fairly incisive and coherent reply. You don't have the effect of thinking up snappy comebacks ten seconds too late. On the other hand, the messages go back and forth so rapidly, perhaps several times a day between any two particular participants-that it is completely unlike first-class mail, which is so slow that you really lose the interactive characteristic. It is unlike the telephone in a couple of important ways, too. I can communicate with someone at a time of my choosing, not wait for him to answer the phone or get filtered through his secretary. Nor is he interrupted by the message in what he is doing. ...The way that this mode of communication affects the company is that it has a very strong democratizing effect. It would be almost impossible to enforce communication through the channels defined by an organizational chart. My boss may send a message to me with a copy to the people who report tome, and like as not one of them will have replied to it before I even see my "mail." This can make some people pretty uncomfortable. ...This kind of communication is not a substitute for face-to-face communication, as we've been discovering. We've got to get together occasionally to have round-table discussions. ...But the benefits are pretty substantial. Most time-sharing services that cover a wide geographic area have

> something similar. I think ours is one of the easier to use, and most flexible. We transmit 175 to 225 messages a day - that is the serial listing, because each of the messages might go to a large number of people [6].

Dr. Philip Abrams, director of research at the Bethesda office, says that it would be impossible to operate STSC without MAILBOX [2]. Users report that participating in computer conferencing is a powerful democratizer. It is very hard to keep information from flowing freely and to reduce the ability of persons to participate, once they have mastered the basic skills needed to operate the keyboard of a remote terminal.

Computer conferencing was used in the spring of 1970 to conduct a Delphi on the design of computer conferencing and to evaluate potential applications [39]. The data processed were a total of ninety-nine assertions about various features of the technique and its potential applications. The panel could give

judgments on the importance, degree of confidence, validity, desirability, and feasibility of each statement. The printout following analysis of these data showed the distribution of group judgments and the degree of dissent from majority views on each statement. Some of the findings were:

?? A strong majority of the panel felt that the system could be used to convene one-day conferences, given the current availability of terminals and' printers.
?? Because length of messages in the version examined is necessarily limited, the panel did not feel that computer conferencing could replace work by committees, and that it is not suitable for joint editing of draft texts or reports.
?? The panel liked the idea of incorporating a "wait" feature which would trigger the terminal when a new item or message has been entered from another terminal. This would enable use of the system for an intensive, scenario-type of simulation lasting perhaps a day, with the monitor feeding in events and getting reactions.

In reviewing the experience, Turoff commented on the expansion of effectiveness coming from joint consideration of the system by a variety of analysis and system designers: "Many of the suggestions made for improvement of the system appeared, once stated, to be so obviously beneficial that this part of the discussion was not always rewarding to the designer's ego. Behind this observation is one of the difficulties in getting decision-makers to risk Delphi exercises." These remarks relate to the observations from STSC regarding the democratizing effect of wide information sharing, and the threat this seems to pose to some people who, attempt to exercise influence by restricting information flow [17, 18].

Some Possible Futures for Computer Conferencing

The widespread extension of time-sharing capabilities and computer networks [8, 26] should further accelerate the practice of conferencing via computer. Turoff explores the implications of these probable developments as follows:

> ... the forthcoming wide introduction of digital data networks will probably provide computerized conferencing systems with another order of magnitude edge in costs when compared to conventional verbal telephone conference calls. Thus, economic pressure may force the various (technical) problems' (of computer conferencing) to be resolved favorably, so that computerized conferencing becomes a major application on such networks. The anticipated future reduction of costs, by the late seventies, for computer terminals with CRT, perhaps placing them in the same purchase range as home color TV receivers, suggests a picture of future society in which a major substitution of communications for transportation ; can take place [40].

It should be clear from the preceding discussion that conferencing via computer is still in an embryonic state. A number of systems, each with distinctive emphases, are in various stages of development. Some data on costs compared with benefits already available are intriguing enough to merit further and more definitive analysis. Such analysis should, for example, be sufficiently cogent and detailed to enable an organization to make considered choices in planning or installing teleconferencing capability (computer, telephone, closed-circuit television, or some combination of these). The reasons for making such considered choices are increasing daily. A recent study by Richard Harkness, on the future of telecommunications, gives some of the reasons why use of such alternatives (conferencing via computer and others) may be expected to accelerate:

> ... what appears to be emerging is a competition between communications and transportation facilities for servicing a large number of contacts that now require travel but which might possibly be made electronically. ..At appears that communications services can be extended and improved more readily than can transport services, since communication facilities have low visibility and are largely controlled by private firms whereas transport facilities are highly visible, controversial, and dependent on a public-political decision-making process for implementation. Therefore, it is possible that communications will tend to improve faster than transport and a relative shift from real travel to tele-travel should result [22].

The broad implication of this and similar views is that through telecommunications there may be more *considered* choice-in research and problem-solving, in organizational activity generally, and in the form and functioning of communities-so that *forced* choice will be less necessary. As teleconferencing is more widely considered and tried, it can emerge as not only a second-best alternative to "being there" but as a positive advantage in many kinds of information-sharing, problem-solving, and managerial processes. Some of these possibilities are sketched below. These are both extrapolations from what is already happening, and prophecies that might turn out to be self-fulfilling.

1. Research and Problem Solving: Many research problems today are not only multidisciplinary but "multi-epistemological" in character. For 'topics such as collaborative physical design of buildings and other spaces, assessing the potential

impact of new technologies, or deciding among various priorities for effort in a research problem, not just "apples and oranges" but "pears, pineapples, and pine trees" as well must somehow be reconciled. Different experts, stakeholders, and process people in such projects will have different mind-sets, different ways of seeing the world, and different bases of expertise to draw upon in coming up with the required solutions. Good solutions, increasingly, cannot be imposed by fiat but must result from heuristically, iteratively combining information and ways of thinking about information.

For this, highly interactive systems that can involve many participants over extended periods are needed. The system must be capable of highlighting and explicating differences in point of view, so that "who is thinking in what way about the problem" is considered as well as "what is the problem." [1$]. As. Christopher Alexander has noted, there needs to be a continual interplay of figure and ground, form and context; this becomes essential in a society where problems are "nested" and workable solutions require *induction* from iteration of, many factors in various combinations [1].

For this process to occur, technology such as that available in computer-based conferencing is required, so that the record of interactions-providing enough detail to show thoughtways as well as data - can be examined by facilitators of the conferencing process and other individual participants.

After all, there is no such thing as "the facts." A fact is a statement about an empirical phenomenon which implies a conceptual scheme or frame, 6V reference. For problems that force contrast and consideration of different perspectives, people need to learn to make distinctions between various possible versions of "the facts," distinctions that are not inherent in the facts themselves but which derive from the purpose at hand. Is urban transportation "primarily" a source of pollution or a process of interaction to make communities operate? Is "the energy crisis" a threat to "our way of life" or an incentive for considered choice? These are instances of broad problems in which the frame of reference makes an enormous difference in the kind and cogency of the solutions reached. There are a host of detailed research and problem-solving tasks in which there needs to be a way of making explicit how the definition of the problem implies solutions. Linkage of workers on the problem with a continuous record of their interactions is essential to such situations.

Computer conferencing opens up the possibility for researchers and policymakers of an electronic newsletter-like service, one which would be much more interactive and information-rich than the printed version. The newsletter "subscribers" would constitute a permanent conference of variable membership; each conferee could receive messages sent "to all members, additional news or greater detail in an augmented service, or answers to queries - electronic letters-to-the-editor. Such a system would be particularly useful for integrated complementary research programs at a variety of locations, or tying together special-interest subgroups within professional and technical societies.

Computer linkages could be used to speed and enrich the presently rather pedestrian process of research contracting, from the request-for-proposal stage through completion of the work and even including dissemination of the results [29]. For example, an agency requesting qualifications of potential contractors to carry out a given assignment might query a number of them via computer conferencing on a quick assessment of the proposed

task and a rough estimate of costs. Proposers offering the five most promising methods of approach and preliminary estimates of cost might be funded minimally to prepare more detailed technical proposals and more careful cost estimates. A review panel or panels might also be convened via computer, and even interact through the organization requesting proposals as the proposals come in. This would be done in real time so that the whole procedure would be much speeded over present practice. A side effect could well be the emergence of new, collaborative interest groups. Potential contractors and reviewers, by having interacted on the original proposal, might well discover other shared interests and additional bases, for information exchange: - And it would still be possible to protect proprietary data by encoding messages for various degrees' of confidentiality (as in EMISARI and MAILBOX).

2. Organizational Behavior and Management: The capability of conferencing via computer, along with other kinds of telecommunications and information processing, can undergird a new definition of management - techniques by which complex systems are designed, developed, operated, and evaluated. For about ten years students of organizational behavior have been asserting that organizations will have to become more "temporary," "adaptive," "flexible," "team-based," and "responsive" or they will be inadequate tools for dealing with new demands and opportunities in a turbulent environment characterized by rapid change [5,30,35]. More sophisticated and sensitive ways of sharing information, making decisions, and coordinating different kinds of specialized undertakings are required to make such organization forms actual rather than, as at present, largely programmatic.

There is considerable indication in the literature on innovation and technology transfer that small organizations are more innovative than larger, and that the barriers to the diffusion of innovation within large organizations are considerable [3, 4, 31, 32]. Within large organizations, it is the individual or the small working group that is the source of innovation more often than not [19, 37]. This would suggest that for the management of innovation, the stimulation of creativity, and the diffusion of innovations achieved, it would appear practical to augment the capabilities of these small organizations or organizational units by adding to their working equipment the kinds of computer conferencing resources discussed here. Similar opportunities would be appropriate to provide for technical associations that have a need for information exchange and problem-solving on a regional or national basis, such as: meteorologists-plus-air-traffic-controllers, newsgathering-processing-dissemination organizations, those responsible for building-code interpretation and enforcement, the probably emerging "community" of weather modifiers, members of widely separated project teams in engineering and construction organizations, and a host of similar groups who need to exchange current lore or benefit from each other's innovations.

In underdeveloped countries, the cost of linking villages by computer is well within the means of present technology and would represent a cost per village equivalent to providing a small truck to each community [44]. The network, once installed, could be used for bid-and-barter exchanges, information inputs to regional or national policymaking [13, 14, 15, 24], queries of government officials (which would make it necessary for government to be more responsive), and even personal messages or short letters. In some instances this might mean that a developing area or country could bypass telephone technology and leap directly into the more flexible, higher capacity types of communications technologies now

available [13, 24]-much as in many such countries there has been a leap from oxcart to aircraft . in transport development. The main constraints would appear to be psychological, social, and cultural. As in the case of the erosion of bureaucracy in so-called developed countries, the social and institutional structure of more traditional, less industrialized societies might be seriously strained by the introduction of such highly interactive communications systems on a large scale. Yet the possibility that such innovations can be installed forces a consideration of social and psychological costs and benefits, and at least some of those concerned with regional or national development in the less industrialized world will want to make such assessments.

3. Considered Choice in Communication and Transport: Ten years ago Melvin Webber outlined the concept of "urban realms," a view of life and work in an urban society in which urbanity would be defined less by geographic concentration and more by the intensity of interpersonal linkages.

> ... an urban realm.. . is neither urban settlement nor territory, but heterogeneous groups of people communicating with each other through space....the special extent of each realm is ambiguous, shifting instantaneously as participants in the realm's many interest communities make new contacts, trade with different customers, socialize with different friends, or read different publications... the population composition of the realm is never stable from one instant to the next [47].

Energy shortages and other difficulties in operating urban communities because of continued emphasis on concentration should revive this idea -and. give it new significance. Recently, for example, Webber has urged that the thinking about urban transportation be put in a broader frame [46]. It is necessary to take seriously the dictum in every Geography .101 course that transport shapes, as well as is shaped by, the city. Both communications and transport need to be assessed and considered choices made; the options for transport should not be limited to servicing foreseeable "demand" with all else held constant.

If such a view were really to take hold, it would undermine much current "comprehensive" urban planning, which assumes current patterns of land use, work-home travel, and existing transport and communication facilities. As Harkness notes, costs and benefits (even in economic terms alone) may lead to a use of telecommunications as a tool for reshaping urban form-office locations, urban travel demands, transportation investments, and a host- of related variables [21].

The same theme surfaces in recent discussions of population distribution and efforts to see how "urban blight" might be relieved by revitalization of smaller cities and towns. William Ewald, for example, extends the view of urbanis m-asinteraction and shows how this could be accelerated by public policies and programs that would increase electronic linkage as an alternative to transport:

> [There has been] scant attention to the enormous potential impact of telecommunications on lifestyles and settlement patterns ... a force as potent in its potential effects as the automobile and the expressway... It is in changing the meaning of time and space that the technology of transportation and communication can have its most profound effect on population dispersion. Government policy could "interpret"

> this technology with important effect. Every time the federal government writes a regulation, it is, in a sense, creating artificial gravity. Especially with the capabilities of information retrieval, computation, education, servicing instruction and conferencing via telecommunications, does propinquity lose some of its reason for importance.... Settlements exist primarily as a reflection of ... efforts to increase opportunities for interaction. It then follows that both individual locational behaviors and overall spatial structures are mirrors of communication. With the changing patterns of communication that are imminent, we can expect that the individuals' locations and that overall spatial structures will also change-possibly in very dramatic ways.... For it is interaction, not place, that is the essence of the city and of city life [16].

This last section of the discussion has emphasized the importance of several new forms of telecommunication. Conferencing via computer is only a small and (so far) relatively little-used example of such new techniques. But computer conferencing is ,a "leading-edge" or "bellwether" technology within telecommunications as a whole, because it is especially well suited to the kinds of information exchange and problem-solving that will have to go on in order to bring about the needed new ways of operating organizations and communities.

The probably rapid decline in the cost of remote computer terminals, alluded to earlier, is perhaps the key development to accelerate wider use. If the cost of a remote terminal approaches that of a color television set, a logical expansion to expect would be the installation of such terminals in many homes and most businesses. Wide access to computer communications via this medium could have a major impact on postal services. Communication via computer might well be the medium of choice for the vast majority of first-class business and personal mail.

Another implication: this wide availability of terminals would make it possible for the first time for individuals and groups to connect with each other or discover each other's existence on the basis of shared interests, rather than by job titles, organizational purposes, or personal introductions of mutual , acquaintances. Wide consequences of such a possibility can be readily imagined, not only for work habits but also for new leisure and entertainment pursuits. In work life it would clearly accelerate the decay of organizational loyalties; people's main primary affiliations would be more likely to be with those with shared interests, wherever they might be and whatever organizational affiliations they might have.

It would seem that computer conferencing has the potential of becoming a communication/problem-solving medium that offers a believable way to directly challenge the current rapid drift toward an impasse caused by too much information, too little time to process it, and too little capability within human beings alone to interrelate and evaluate information even if processed [34]. There really is no alternative to more considered choice of methods for information exchange and problem-solving: better ways of sorting and routing information, easier access to information, and augmented capacity to, act. There need not be an Era of Forced Choice. But avoiding this condition will require energetic effort to make wider and more creative uses of such technologies as conferencing via computer.

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