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# The Anatomy of a Computer Application Innovation: Computer Mediated Communications (CMC)

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The mighty telescope looks afar,
But finds no place to park a car.

—Samuel Hoffenstein, Pencil in the Air

## Introduction

It is quite easy to observe that computers have had a major impact on our society and to predict that this trend will continue. While it is possible to come up with specific predictions on various aspects of the technology such as expected performance of new hardware announcements, we have a very spotty record about anything dealing with the interaction of computer and information systems with individuals, groups, organizations, and society. The problem is not that someone has failed to predict specific impacts that will occur, but that there are so many predictions that some will be right only by random chance.

Most predictions are made by individuals and organizations within the computer science discipline and the computer industry. For each correct prediction, one can usually find a number of equally impressive predictions that were wrong. In fact, it might be said that we have a great deal of difficulty determining what is currently going on, let alone in the future. For example, the debate in the literature as to whether computer systems are a net creator or destroyer of jobs is still an open issue. It is doubtful that we will ever be able to resolve that issue. People within the industry often remark that the companies who succeed do not do so because of accurate forecasting or planning, but because they make the fewest mistakes. Perhaps the first generalization to offer the reader is that predictions made about the computer field by those in the field are the most suspect of all of the predictions.

Since the late 1960s I have been involved in the design, development, and advocacy of the use of computers to facilitate human communications. In the early 1970s, with the enthusiasm of an innovator of one of the first systems [1], I found it difficult not to believe that this application of technology would be widely accepted in a short period of

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time. All of the benefits and advantages seemed too logical and obvious to be ignored. Needless to say, I have learned a considerable number of lessons in the past two decades.

My objective in this paper is to provide a very personalized view of the area of Computer Mediated Communications. A number of the factors and specifics that have made prediction in this area difficult should apply equally well to other areas of computer application. In that sense I hope to provide some insights that will be useful to others in understanding the impacts of computers on society. Also, after two decades I feel that there are some important conclusions about this area that are semi-accurate at this point in time. There is now a considerable amount of experimentation and supporting data from which one can begin to infer some meaningful generalizations.

Regardless of my past experiences and disappointments, it should be made clear that my enthusiasm for this particular use of the technology is not dampened, nor do I feel pessimistic about some of my earlier predictions actually occurring. My time scale has considerably shifted over the years, but the basic driving forces of the potentials and benefits that these systems offer will ultimately overcome current impediments. This is still, in my view, a new communications medium that will become as commonly used by the general public as the telephone is today [2].

**A Rose by any Other Name . . .**

Perhaps one of the best ways to gain a perspective on this technology is to consider the various names that been used to describe it. In the computer field we have a problem of jargon that derives from the fact that we are dealing with a highly commercialized endeavor. Vendors marketing products and organizations sponsoring development work have a great deal of pressure to ascribe uniqueness to what they do. They seem to go out of their way to find a new name for something even when it has already been done. Sad to say, some of this has spilled over into the academic community, and results in the observation that many computer applications get reinvented in different academic disciplines. The paradigm almost seems to be that one needs to find a new name for something to be able to write about it.

A related commercialization problem is the subject of metaphors. The basis upon which most computer applications are sold is the concept of automation. All the computer does is to automate something that one is already doing manually. The computer just allows one to do it faster, easier, and cheaper. A computer application does not change anything the user or the organization is doing. Selling the idea of no fundamental change through a new computer application is the way that most applications are sold. Therefore, one tries to find metaphors to describe a system that will make the customer feel comfortable. This approach has had a very strong influence on the nature of the systems that make up the current market for Computer Mediated Communications. To some extent this factor has influenced the functionality of available systems and the names by which they are called.

While I coined the name Computerized Conferencing back in 1971, I have come to believe that a more appropriate name today is Computer Mediated Communications (CMC). This would seem to encompass any system where the computer is used to mediate communications between and among humans as individuals or as groups. At the least, it provides a title which encompasses the full range of research that is possible in this area. Another label that is used which is adequate is Computer Augmented Communications (CAC). Each of the names below represents a differing perspective or, in some sense, the viewpoint of differing "lobby" groups that make up the field.

**Message Systems; Electronic Mail Systems (EMS); E–Mail**

The earliest CMC systems were "message systems." Scientific Timesharing in the mid to late 1960s probably had the most highly developed early message system and the first that was used for real management applications. That early system (MAILBOX) had both certified and registered mail and a centralized file of mail to establish a management record when needed. Later systems on ARPANET and elsewhere were far more primitive in design.

Basically, a message system embodies the idea of automating the post office or the internal memo. Technically it usually works by sending a copy of the delivered message to each recipient's personal file. The lack of a concept of "group memory," or ability to share a single copy of a set of communications, is a key to the limitations of message systems. The current generation of message systems is oriented to transmitting message traffic across computer networks or local area networks. Although many have introduced group oriented features such as group mail, they are still a very limited technological personification of CMC systems. They are by far the most popular since they represent an easy to understand metaphor and can be sold by vendors as the mere automation of something that people are doing now with internal memos and phone calls. Hundreds of thousands of people in organizations today are using message systems of some sort.

There have been attempts by authors associated with various vendors to claim that the "message system" is the most general concept of CMC. Most of the international standards efforts are still focused on the idea of standardization of the "message." Part of this problem stems from the predominant influence of communication companies in the international standards effort. This was quite clear in the literature of the late 1970s. However, while there was some recognition of the potential in some of the R&D areas of phone companies, it turns out that the upper management in phone companies was too absorbed in video conferencing and broadband technologies to give priority to this area. As a result most of the popular message systems are offered today by the computer industry vendors, with IBM and DEC leading the pack (PROFS and VAXNOTES).

For a while the terms "teleconferencing" and "telematics" were regularly applied to this area in articles from authors associated with phone companies. Fortunately the use of these names seem to be decreasing. The fact that the phone companies lost their initial edge in this area may explain the recent decline in classifying this technology under "tele"-type titles.

Perhaps the worst thing about message systems is their popularity. Too many message system users think they know what CMC is or can be, based upon the impressions they gather from the use of message systems. As a result it is often hard for them to understand the possibilities or functionality that other forms of CMC provide.

CMC systems have their most startling impacts, even message systems, when they enhance informal organizational communications. One can design message systems to be so similar to the formal internal memo that users do not attempt to use them for informal communications.

**Computerized Conferencing; Computer Conferencing; Collaborative Systems**

The first Computerized Conferencing system was an automation of a Policy Delphi [3] that evolved in 1971 to a crisis management reporting system (EMISARI). One tool of that management reporting system was a linear conference transcript structure to store a data base of everything a group discussed. Most people seemed to get the impression that this simple stored transcript system was what was meant by Computerized Confer-

encing. This was very unfortunate in that the total management system was a highly structured set of communication tools with software support for a large number of human roles that were defined in the communication process [4, 5, 2]. In the EMISARI system, for example, the collection of data was structured to be the responsibility of different individuals identified with the data when it was retrieved. Any system member could send messages to individual data items so that those interested in certain data items could see what comments were being made about the data. One did not have to know ahead of time whom would be interested in what data at any moment. Each data report became the label for organizing a conference.

The fundamental idea of Computerized Conferencing was the ability of the computer to provide both communication structures and tools tailored to specific groups, specific applications, and specific communication objectives. It was based upon the concept of the Delphi Method as the art of structuring human communications about complex problems [6]. Computerized Conferencing really grew out of the idea of putting Delphi communication structures onto the computer. Since most of these structures utilized graphical representations and relationships, the objective is still unrealized. Now that most organizational personal computers can deal with graphics, the opportunity to carry through that goal is now a reality.

Just as one may structure a face-to-face meeting in many different ways, so may one create a variety of structures for a Computerized Conference. However, when one builds a similar sounding structure in the computer, it does not lead to the same sort of human communication behavior. For example, in the use of Computerized Conferencing to support education, we use a special structure for asking discussion questions, just as one would in a face-to-face classroom. However, on the computer we do not allow the students to see the other student discussion answers until they have supplied their own. This completely changes the nature of the "Virtual Classroom®" as compared to the "face-to-face classroom."

Aside from the EIES system developed at the New Jersey Institute of Technology, all the Computerized Conferencing systems that have been offered commercially over the past decade have largely been examples of singular designs without the flexibility of adaptation to differing needs. Each of the systems had certain advantages or disadvantages that made them desirable or undesirable for certain types of applications. The reality of Computerized Conferencing to date has not come close to the original vision.

However, this is not the fault of designers as much as it is due to the difficulties of implementing such systems on top of computer operating systems that were never designed to support human communication structures in the first place. In any case, the diversity of different systems implemented in the past decade [7] has given us invaluable experience in terms of now having a much firmer foundation upon which the next generation of Computerized Conferencing systems can be based. However, we still have the problem that a great many users perceive Computerized Conferencing as having the attributes of one specific system: a Participate, an EIES, a FORUM, a NOTEPAD, a COSY, a KOM, a CAUCUS, or an EQUAL system.

**Bulletin Board Systems**

There must be well over 10,000 active bulletin board systems in the United States today. It is amazing that they exist almost ignored by either the communications or the computer industry. The original bulletin board was someone's personal computer programmed to allow public posting of notices or messages much like a physical bulletin board. There are bulletin boards in existence for all sorts of specialized communication

groups: amateur pilots, astronomers, scuba divers, Gay groups, the Nazi party, etc. The number of high school students I encounter who operate their own bulletin board systems is amazing. A number of bulletin board networks have also been set up in various foreign countries. The current existence of these systems and their popularity expresses a need for communications that is not satisfied by other modes of communication. The new 900 telephone number party lines express the same desire for better communications but provide a much less satisfying service. One day it will be possible for any small group, no matter how scattered through the world, to both find one another and to communicate economically via CMC systems. People want to use the content of their message as the address to reach other people, and no other two-way communication technology makes that economically possible on a wide scale.

The power and potential impact of CMC is not only in the ability of people to communicate when it is convenient for them, but in the fact that the computer can be used to allow people to find one another and to organize themselves into groups. Today, in our society, this is a very costly process and is a basic limitation on organizational and societal processes.

Essentially, Bulletin Board systems express the fact that it has become economical for a small geographically dispersed group to set up their own personalized communication process. It is the indication of a demand that has not been satisfied. As personal computers become more powerful, so the Bulletin Board systems are becoming more flexible. Many of the newer ones now offer private messages and versions of private conferences very much like the early Computerized Conferencing systems. What is startling is that for an investment of under $10,000, an individual can offer a tailored communication service for a few hundred people. Today, most of these systems are operated for free or as part of a service based upon membership in some club, hobby group, or organization. I tend to believe that we will see significant commercial recreational services evolve out of this area. Providing such services as a 24 hour a day capability for groups of four to find one another to play bridge is one example of a commercially viable recreational CMC system service possible today. This is a concrete example of a high degree of tailoring and structuring of a specific CMC system for a specific application.

### Computer Supported Cooperative Work Systems (CSCW'S); Teamware; Groupware; Coordination Systems

The latest jargon to emerge for CMC systems seems to be CSCWS, systems designed to support teamwork. The success of some personal computer based packages such as Coordinator has led to this recent wave of new terminology. Articles on this have appeared in such places as Business Week and Fortune. The term Groupware was first coined by Peter and Trudy Johnson Lenz [8] in referring to some of the design work they did on tailored subsystems on EIES to support industry committees working on setting standards via Computerized Conferencing. However, those roots in some of the original Computerized Conferencing systems that were used for large team efforts are completely lost on most of the new writing about CSCWS. Somehow this area has been made to appear as a brand new discovery of how computers can be used.

The danger here is the same one that the early Computerized Conferencing systems fell into. The impression being conveyed in CSCWS is of highly tailored specialized systems for specific tasks. The long term result is absurd. Users will not tolerate using a different communication system for each type of communication task.

Another part of the problem is that many of these efforts are ignoring what has been learned in the past two decades and, in some cases, what is already known about human

communications from social science literature. Many papers exhibit the property of taking a capability already developed, adding communications, and then trying to find a problem to apply it to. The idea of looking at the group and its needs before designing the system is still something very new to most efforts in this area. It has been our experience that the best systems evolve in collaborative design with the user groups. Groups need to evolve their own communication structures and the duties of the human roles that support them. Even in corporations there is a large diversity of social norms and types of corporate culture. Within the same corporation a significant diversity may exist in different parts of the organization.

This particular area of CMC today is very much a victim of commercialization and the property of "solutions seeking problems."

**Group Decision Support Systems; Electronic Meeting Systems (EMS)**

Group Decision Support Systems (GDSS) have emerged from the area of management science as an extension to Decision Support Systems. However, the actual systems being implemented in this area appear to be far more like Delphi Exercises or Nominal Group Designs than the sort of model building and database tools that were touted as the original DDS concept. For the most part GDSS's are systems to support voting and organization of decision material (e.g., alternatives, criteria, etc.) into a computer supported structure. Most of these systems are being designed to support face-to-face meetings. In fact, some writers have even assumed this concept only applies to simultaneous interactions.

In fact, GDSS will not succeed unless they are designed to support communications asynchronously as well as synchronously. In that regard they are not anything new relative to the evolution that Computerized Conferencing systems have gone through. Almost every feature in the current generation of GDSS can be found in some earlier conferencing system design.

One cannot help but observe that now that the computer science people have discovered CSCW and the management science people have discovered GDSS, Computerized Conferencing has made a step forward in regard to acceptability. One can probably safely predict that neither academic community will ever read each other's work.

It is impossible in the study of CMC systems to divorce the design of the system from the group and its application. The proper investigation of these systems is truly an interdisciplinary undertaking. We have not solved the problem of interdisciplinary research in academia, industry, or on the part of research sponsorship organizations. In fact, we have probably retreated in that area relative to the 1960s and the heyday of the non-profit research institutions.

In defense of many of the management sciences efforts, they are spending a lot more effort on basing their work on what is known about human communications, and on trying to confirm the value of their efforts with proper evaluation efforts and controlled experimentation. Theirs is a more rigorous approach to the development of underlying theory to support the designs.

Recently a number of these efforts have suggested using the term "Electronic Meeting Systems." The argument given at one professional meeting was that people do not understand what GDSS means and it is therefore hard to sell. People will think they know what EMS means and will more easily accept it, or they will think they are getting an Electronic Mail System (also EMS) and not object to it. Recently some of the GDSS efforts that had tried to define GDSS as only in support of face-to-face meetings have claimed that they must construct "Group Memories" so the system can be used asynchronously. This is claimed to be a "new" insight into what GDSS should do.

Most of the designs for face-to-face GDSS rooms require an investment of about $1 million in a computer equipped meeting room for about thirty or so people. One advantage of this cost is that it does catch the ear of top management. A top management decision is needed for a company to make such an investment. As a result a number of companies have bought one or more copies of these decision room designs. These systems have the same glamor and status appeal as the "command and control centers" sold to industry a decade ago. They also remind one of the concept of MIS presented in the late 1960s as providing a few top managers direct control of the whole company. What we seem to have in the GDSS case is a certain element of providing control of the "decision process." Top management is convinced that every decision analysis group will be forced to go through the same process, and that a record of the decision process will be made available for oversight and accountability. While this objective is much more feasible than direct control type objectives, there are some inherent dangers not yet really considered by those working in this area.

Obviously the problem with CMC software not attracting the eye of top management may be that its price range of $10,000 to $50,000 is too low. However, I think the next generation of CMC systems will be bundled with GDSS rooms to overcome that difficulty.

**Hypertext; Hypermedia**

In the mid 1960s, Ted Nelson came up with the concept of Hypertext. This is the idea that text within a computer system can be dealt with in a non-linear manner. One does not have to read text in a linear manner as one must do with a book or report. True, books have indexes and a table of contents which allow some degree of non-linearity. However, on a computer one can provide information at any point in the text on related textual material. Hypertext has become popular as personal computers now provide sufficient storage and power to deal with it. Having all of a body of literature (e.g., Shakespeare's plays) on one optical disk and being able to search and reorganize it via Hypertext linkages has proved to be a very powerful learning device. One can impose one's own cognitive map and create essays directly linked to material throughout the data base. In the CMC environment, any single communication is usually a small piece of a total job that the user or group is involved with. Therefore, the ability to link and map a large body of communication objects associated with one task is a necessary functionality of the next generation of CMC systems.

Most Hypertext systems allow writers of text to compose text in a non-linear manner. This goes far beyond the flexibility provided by outlining type composition systems. Some efforts in Hypertext have now incorporated communications and attempts to allow groups to deal with a single composition objective. There is a whole family of composition-oriented CMC systems being developed today under the title of Hypertext or Hypermedia. Hypermedia refers to the fact that these systems can incorporate graphics, video images, and electronic voice as well as text. Unfortunately, there is little recognition that most conference systems already exhibited Hypertext structures as a natural part of the communication process. It is amusing that one recent Hypertext system built for dealing with policy alternatives at MCC basically replicates the original Delphi Conference System [1]. While it does add graphics capability to the process, the papers describing this system make no references to any of the earlier related Conferencing work.

The problem of collaborative Hypertext is still one that is not well understood and will require a lot more investigation. It is difficult enough for most people to compose non-linear text, let alone for a group to be able to do it or to understand the results. The problem is one of "information overload" and gaining insight into the meanings of

collective relationships emerging from the group activities. The current generation of Hypertext systems have largely only focused on the retrieval problem, not on the creation problem.

**A Ten Cent Telephone Call!**

Having built my first system in the U.S. Government [3] one of the initial shocks I had was the reaction that one should not use a multi-million dollar computer to do what could be done with a ten cent telephone call. This was reinforced when I went to an exhibit of ARPANET and happened to notice a student from MIT at the back of the exhibit using a terminal to leave a message for his wife. When I asked him what he was doing, he turned all red-faced and proceeded to explain that this was really nothing and I should be looking instead at the fancy things that were being exhibited at the main display stations. Both among the accountant types and the computer types in the early 1970s, there was a certain degree of horror that one would use expensive computer resources for human communication.

In a visit to ARPA in 1971, I asked to get some data on the use of the ARPANET for messaging. In a rather frank discussion it was pointed out to me that they were very embarrassed that the single biggest application of the network at that time was message traffic. This sort of application was completely unintended and had no justification under their formal requests for funds to support ARPANET. As a result they were not releasing any measurement data on applications of the network.

A few years later they rewrote the objectives of this R&D effort to include messaging as part of a new mission to examine management applications. In fact, the ARPA office began to publicize message systems as a great innovation resulting from the ARPANET R&D effort.

In any case, given this early reaction that somehow this was unproductive use of expensive technology, in 1971 I decided to develop a cost model that would show the use of computers for human communication was an economical or cost-effective application. One might say that I was a bit naive in believing that the objections raised to the technology, based upon costs, were a valid pronouncement as to why people did not want to make use of it. That model compared verbal human communications with electronic written communications [3]. It showed very conclusively that in many cases it was cheaper for a group to use computer based written communications than to walk into a conference room. This was based upon the amount of communications among a group that can occur in a unit of time, and the value of the people in the group applied to the time they saved. Remember, in face-to-face or telephone communications only one person can speak at a time, while on the computer everyone can be writing or reading simultaneously. Essentially the result is that a group is operating as a group at reading rate rather than speaking rate, and a ratio of through-put of about a ten fold increase is approached as the size the group gets large. More recent studies in group problem solving via CMC and face-to-face [9] have shown that people in the CMC environment use about one half of the amount of communication units to arrive at equivalent problem solutions. This further enhances the efficiency gains.

Based upon that model, if we were really dealing with "rational" managers whose only concern was productivity, we should conclude that all of management would have been ordering the installation of these systems years ago. It took a while to realize that most people in organizations had reached management positions because, in part, of their verbal communication skills. The result is an unconscious fear that they cannot communicate as well in the written form required by Computer Mediated Communications.

Another factor is that some management people consider their ability to channel the flow of information in the organization as an important component of their power and authority. Many managers are quick to recognize this technology as a threat to established communication channels. CMC systems provide for a widening of informal types of communication at all levels in the organization, i.e., if they are designed to be democratic in nature. There have been message systems designed that allow employees to only send messages to those in their organizational unit. It is possible to design a CMC system to be a dictatorship.

We were once giving a review of our controlled problem solving experiments to a group of vice presidents from a nationally known bank. These were the experiments that compared face-to-face communications with CMC. We pointed that one of the strong findings was a difference in impact on women. In the face-to-face meeting, women do not speak as much as men and give in to male viewpoints. However, in the CMC environment they are much more outspoken and hold to their views in a much stronger fashion. We got some very frank comments from this group that this was a good reason for them not to utilize the technology. The point of this is that managers are very sensitive to anything—and that will be reluctant to utilize anything—that changes their communication capabilities.

There have occurred, over the years, a number of unpublished examples in organizations that have adopted CMC systems where informal working groups have completely upset decisions made by upper management. In one case, an informal team of 40 technical people scattered around the world wrote a counter-proposal report to an already stated policy and had that policy completely reversed. In another corporation, top management came very close to deciding to rip out an existing message system because of the difficulties it was creating for high level management.

Since the introduction of the personal computer, the arguments that computers are too expensive for people to use directly have more or less disappeared. Anyone with a personal computer can also use it as a device to use a CMC system. However, the human and organizational bottlenecks still exist and still slow the introduction of this technology considerably. These bottlenecks have nothing to do with costs or with productivity considerations. Costs and productivity issues are largely excuses used to delay or postpone the introduction of this technology in organizations. The real issues are usually the unspoken ones related to authority and power in the organization and the fear of a lack of communication skills in this type of medium.

This is complicated by the fact that while a low level manager can make a decision to buy a personal computer, the decision to put in a new communication technology has to be made at a fairly high level in the organization. Almost all the companies that have systems today never made a conscious high level decision to have it in the first place. The most typical scenario is that there existed a network between computers in the company, and someone in the R&D division either built or bought a CMC system for R&D use. R&D divisions tend to be able to introduce new technology independent of the usual management process applied elsewhere in the organization. Very often such introductions spread over time throughout the company. It is ironic that the two biggest marketers of message systems, IBM and DEC, never made a conscious decision to install such a system for operational use. Both companies evolved initial corporate-wide utilization without any management planning or decisions for it.

In most cases that I know of where upper management decided it had to do something about the productivity of management communications, the actual decision made during the past decade was to install video conferencing. On a productivity and cost basis, this

is a ridiculously expensive and limiting alternative compared to CMC. There are a lot of very swanky video conferencing rooms in many companies gathering dust most of the time. Video conferencing does seem to provide the status appeal and ego gratification that makes it much easier to sell to top management. Video conferencing is also appropriately expensive to be noticed by top management. For the penetration of CMC systems to the ranks of top management, we may have to wait until the generation of management graduates using personal computers reach the ranks of top management.

An added contributory factor is the nature of the majority of current middle management of computer operations in organizations. The early introduction of computers into organizations first focused on the necessary information that a company needed to stay in business. Knowing whom one's customers are, what they have ordered, and what one has collected are all rather necessary to company survival. Such information has infinite value to the company. As a result the basic principle that governed the design and purchase of computer systems in organizations for the past decade was "cost minimization." Many of the people still dealing with decisions on systems were trained in this approach without a more fundamental understanding of why they use it. It is therefore very difficult for them to consider the implementation of systems based upon data and communications that have a finite value. Most information that is needed for decision making is the subjective, statistical, and uncertain information that has finite rather than infinite value. Computer based systems to support decision making cannot be justified on "cost minimization." Since CMC are computer based systems that support the communication and group collaboration about finite valued information, they are difficult for computer service organizations to justify or even consider. After all, users have the alternatives of face-to-face meetings, travel, phone, and internal memos to carry out the same process. Most of the purchases of personal computers, local area networks, and local E–mail systems have occurred in end user groups, as opposed to being fostered by centralized mainframe computer operational units.

While there is a growing recognition of the need for viewing computers in a "strategic context" [10], the fact of life is that we are going through a period of intense conflict in the degree of centralization and decentralization of computer operations. Strong centralized operations in many companies have made the mistake of trying to maintain the status quo instead of leading the way in such areas as communications and strategic applications. As a result they have lost some of the power necessary to make significant advances in this area.

In their defense, it should be stated that many successful data processing managers made their success by bringing runaway computer costs into line in the organization. Growing costs of computer operations was a chronic problem in the late 1970s and early 1980s. The data processing management innovators of the early 1970s were largely technical people who innovated but did not know how to manage costs. They have now largely been replaced with true management types who know how to control costs, but do not have a sense of innovation. Much of the innovation today appears to be coming from the end user organizations that have begun to hire their own computer experts. This is obviously a broad generalization that has many specific exceptions.

**Evaluation and Academia**

In 1973, while still with the U.S. Government, I was invited to a small academic retreat gathering with a number of computer and information scientists. The talk just before mine was by a gentleman who was proposing that it would be ideal to build group communication structures in computers. In my naivete I thought to myself that he would

be very pleased to hear, when my turn came next, that I had already built and utilized two such systems. At the end of my talk I was subjected by this same individual to one of the worst attacks I had ever had to that point in time, or since. Essentially the claim was that because we had done something in a real setting without careful evaluation and measurement, it was all meaningless. None of the comments I was making about people's reaction to the technology or the utility of the technology in a real setting was worth listening to. At first I was a bit taken back, but it did not take long to realize he was reacting to having discovered someone had built and utilized what he had thought was a unique untried idea. However, his attack had certain elements of truth that stuck with me when I left government the next year to join academia. As a result, one of my first endeavors in trying to set up a research program in CMC was to establish a working relationship with others who had an interest and background in evaluating this technology. This was how the team of Hiltz and Turoff got started.

The reason why the Computerized Conferencing Center at the New Jersey Institute of Technology has operated a CMC utility (EIES) since 1976 is that it provided a real world environment where we could develop and evaluate new software and facilities. In essence it has been a "laboratory without walls." Over the years our research in CMC has produced more in the way of careful evaluation studies of this technology than any other single organization that has attempted research in this area.

At first the work in evaluation was oriented to establishing absolutes and comparisons with other communication media. A great deal of work in developing evaluation techniques for this technology was an important byproduct of the major effort. However, we learned an important lesson from this first orientation of the research. Evaluation results can be utilized to eliminate the common arguments that people put forth against the use of the technology; however, they do not speed the introduction of the technology. The results force people to surface the real reasons why they do not want the technology introduced, provided they want to be frank about them.

It took me a number of years to realize that evaluation processes had a far more important role to play in this technology than as a mechanism to justify its introduction. The significant role that evaluation plays is in its contribution to the evolution of a group's use of the technology. It is a role that should be part of any organization's efforts to utilize interactive systems for managers and professionals in the organization.

There are at least four learning plateaus for individuals and groups using this technology. The first is learning the mechanics of the system, which is not much of a hurdle if one is already using personal computers. The second is learning how to be an effective communicator in the electronic written medium. A successful writing style requires the use of paralinguistic cues to replace non-verbal ones. For people to succeed in relating to others, they must learn to express the social-emotional content of what they are saying. This has been found to be extremely crucial to being able to build a team atmosphere and to aid the ability of groups to reach consensus. This aspect is extremely crucial for geographically dispersed teams working together on a day-to-day basis.

The third learning plateau is understanding the processes and techniques that foster a particular group communication objective (e.g., exchanging information, exploring alternatives, negotiating, etc.). This is where groups formulate the norms and establish the human roles that allow the group process to take place successfully. This is not unlike a group working together in face-to-face meetings, but it often requires much more explicit definition of the resulting roles and, as the group size increases, the necessity of software support tools for these roles becomes paramount.

The fourth learning stage is obtained when the users understand the system sufficiently

in functionality and utilization, both as individuals and as groups, and they can begin to suggest the sort of capabilities they would like to have developed to increase their effective use of the system. These may be features needed to overcome information overload, which usually occurs when a user has greatly multiplied the number of individuals he or she is communicating with [11]. After a decade of observing groups using this technology, we have yet to see a point, for advanced groups, where this last stage terminates. It is the stage where users become part of the design process.

Continuous evaluation that feeds back to the roles that various members have in a communicating group, and to improvements in the design and flexibility that a system offers its users, is invaluable in assuring long term success and associated increased productivity of the group activities. For example, very little work has been done on linguistic analysis of ongoing conferences; however, we feel that it is possible from such an analysis (in real time) to provide facilitator and leadership roles clear indications of developing problems in the group atmosphere.

Studies of productivity in the sense of improved quality of work, rather than quantity of work, indicate that productivity gains are tied to widening the network of people that one communicates with [12, 13]. It is possible, with this technology, to increase by a factor of ten the number of individuals one can maintain a working relationship with. The fact that a continuous evolutionary process can take place, if the CMC system is rich enough to support it, was expressed in a number of our writings [14, 15].

We also discovered another interesting offshoot of the evaluation work. The medium itself could provide a new technology for studying the human communication process that greatly reduces the effort needed to conduct similar studies using face-to-face communications. It was, in fact, possible to discover things that were independent of medium of communication. CMC was a new tool for the study of human communications [16]. However, this observation has yet to penetrate most segments of academia that profess to study human communications.

Ironically, in merging social science evaluation methodology with computer applications development, we encountered interesting reactions from both disciplines. Dr. Hiltz has a number of interesting letters from some of the more prestigious social science journals which say things like: "As editor I decided to reject this paper without sending it to referees because it is about computers." From many computer scientists we received the reaction that because so much of our effort was studying people and groups, we could not be studying computer science. There are still many people in both fields who think this way. However, about 1981, and largely due to Ben Shneiderman's book on software psychology and the increasing costs of software and the cost of application failures in interactive systems, the study of people and behavior has become a much more accepted part of the computer science field. Also, the introduction of personal computers has converted many prior anti-computer social scientists into confirmed computer lovers, and some have even gone on to find things to study about them. A few computer companies have even hired some social scientists into positions concerned with the evaluation of computer systems. However, most companies have yet to learn the evaluation process must start with the design and not the finished product. Many social scientists employed in the computer industry still feel like a token in the organization. For rich computer systems, the evaluation process has to be continuous and not a one time thing.

Perhaps one of my most significant accomplishments in this regard was to get a course introduced two years ago for graduate students in computer science on evaluation techniques for information systems. Even academia does change when given enough time. However, one cannot help but note that ACM acreditation requirements for computer

science do not yet incorporate basic requirements in human factors, cognitive psychology, and related evaluation methodology.

**Visions and Design**

As a result of 20 years of work in this field, I would like to offer a summary of what I feel are the major observations and conclusions about CMC systems.

There have been very few innovations in two-way communications. However, each one has had significant influence on our society: the postal system, the teletype and telephone, radio, and television. Digital based human communications promises to be as significant as any of the earlier innovations. It must be ultimately recognized that CMC is a new and unique form of human communication, with properties that are very different from other available forms of communication. It is wrong to try to compare it and pigenhole it as some combination of existing forms. It produces very different behavior and social patterns for the groups and organizations that make effective use of it. It also will be, in my view, a technology for the masses. One day it will be as necessary to every citizen in society as the telephone is today. This view was expressed many years ago [2] and still represents the perception of many of us working with this technology.

However, over the years I have greatly reduced my expectations as to how fast this will occur. Today I am firmly convinced that the major penetration of this technology will first occur as a method for providing distance education. This is already very much underway in other countries that have large "open university" programs such as England, Denmark, and Sweden. Our own work in the area of the "Virtual Classroom®" and its extensive evaluation studies [17, 21] show conclusively that one can deliver college level education as effectively through CMC as in the face-to-face classroom environment. In fact, the results seem to indicate that it is more effective for the better students.

Message systems will spread quite fast among all companies that have networks of computers, but more sophisticated systems for management purposes will have a much more gradual evolution. There are a number of factors yet to be realized before CMC will achieve its promise in organizational situations. First, it must be recognized that the design of a CMC system within a specific context is the "design of a social system" [18]. The ways people communicate with others are very much a personal choice, and the specific objectives of the process determine both individual and group behavior. It is insufficient to design as if one is designing a computer system alone. One must factor in the people and the applications. Also, the design itself will, over the long term, influence the behavior. It is possible using the computer to design anything from a very democratic process to a complete dictatorship. The classic Bulletin Board is very much a democratic design. A system like the "Virtual Classroom" actually dictates the sequence by which students and engage in certain discussion activities. Some message systems allow control over whom one can message.

There are a number of concepts that are crucial to the next generation of CMC systems. While they are exhibited in some degree in current systems, they are largely unexplored. The first is the possibility for the "content to be the address." For letters and telephone, this is not possible. In the computer, the topic can determine who will receive or retrieve the communication. There are many very different and tailored alternatives for taking advantage of this capability in different application situations.

The second is the use of "adaptive text." Within the computer text can be alive. Text and executable programs or links to other media can be a dynamic part of the text. The resulting text can interact with the reader just as a program does. Messages can request information from users and automatically route it back to where it is needed.

Poets can write poems that are animated. Merging voice, music, video, and text dynamically within the computer will lead to new art forms and new ways for people to express themselves to one another.

The third area is the support of human roles by the software that is built into CMC systems. The informal roles of gatekeepers, information brokers, and facilitators that take place now in organizations will ultimately become more formalized in the context of CMC systems and lead to real jobs within organizations.

The definition of a new generation of this technology, in my mind, is one where the power to tailor the tools and communication structures must be raised to the level of the users as part of their conscious choice and capabilities. This will define the nature of the second generation CMC systems, and it is very much a part of the considerations in the systems we are now developing. For everyday use as part of an organization and as the principle mechanism of organization communications, CMC systems must be adaptable to the full range of communication objectives.

Another key concept is the need to view human communications as a general metaphor for the interface people should use to communicate with all computer and information resources [22]. There is really no reason why the same processes that a human uses to communicate through a computer system with other humans cannot be used to communicate with other computer resources. Sending a message to a program or a database can be done by the same operation used to send a message to another human being. Communications is the ideal theme for providing a single integrated interface for humans in an information system environment. The integration of CMC systems with other computer resources will be the key to widespread organizational use of the technology.

Unfortunately, most of the current generation of computer executive software does not lend itself to making this an easy technological development task. In our new CMC systems, we have had to develop the system as its own operational executive with its own object oriented databases [23]. In order to provide humans the same sort of rich set of communication privileges they are used to in verbal and face-to-face communications, we have had to introduce some 30 or so privilege concepts that go far beyond the three or four provided in most computer executives (e.g., read, write). Things like the ability to make "requests" of others, to "link" other material to theirs, and to "file" in another file without being able to read what is there, are all capabilities that humans are used to and have a right to expect in a CMC environment. With adaptive text one must introduce new privileges associated with who is allowed to trigger executable text for others.

If there is a single long term design goal that I have had faith in over the years, it is the concept of "collective intelligence." This is a very measurable objective relative to many of the objectives expressed for computer and information systems. It is the question as to whether a group utilizing an appropriate communication technology and support tools can reach a better result than any individual in the group acting alone. Over the years we have provided evidence that this phenomenon exists and can be demonstrated, and that it may be more likely in the CMC environment than the face-to-face environment. One might consider the current hype in the computer industry with respect to "expert systems" designed to replace humans, and ask if the same techniques applied to aid a group, rather than replacing it, might produce better results. In the Artificial Intelligence (AI) and Expert System area far more attention is being paid to replacement than to augmentation of humans. Unfortunately, the academic paradigm is to utilize AI to replace rather than to augment human intelligence, and the vendors can more easily sell systems justified on replacement than on improved quality of what humans are doing. The unexpressed feeling of management that face-to-face meetings do not often exhibit collective

intelligence is probably a hidden factor leading to the wave of investment in GDSS facilities.

Unfortunately, an objective of group augmentation for AI and Expert Systems would lead to very different R&D efforts than most of the current work and projects. The disciplinary nature of the teams involved would have to undergo significant change as well. It is a key area in computer science where some basic re-examination on the part of those sponsoring research is sorely needed.

It is now almost two decades since the first Computerized Conferencing System was implemented and utilized. We appear to be just entering the upward slope of a very confused substitution curve. We are probably at about a level of a few percent on the curve. I expect it will take another two decades to bring us to the upper range of the curve. Along the way I believe we will see some very fundamental changes in the nature of organizations that use this technology [19]. There are a few developed countries that appear to be moving faster to utilize this technology than the United States (e.g., Canada, Sweden, Denmark). The potential for countries that live by exporting and for developing countries is so great [20] that one can expect international applications to move ahead quite rapidly. Certainly many multinationals could no longer operate effectively without their growing message systems. However, the most startling of all the applications I foresee in the next 20 years will be the public utilization. In education it will mean that colleges and universities will no longer have geographical monopolies on students. Distance education, continuing education, training, and life-long learning will move very rapidly to the utilization of this technology and local community systems are very likely to be the following step in public use of this technology. Either commercialization of Bulletin Board systems will occur and/or the banking, publishing, telephone, or cable television systems will attempt entry in this area. While it is unclear what direction it will come from, it will still come. The most significant impact will be on local community politics and the political system. With respect to public applications, it is very analogous to the pump already being primed, and the uncertainty is who is going to turn on the spigot.

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