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**IMPACTS OF INTERACTIVITY FROM COMPUTER-MEDIATED
COMMUNICATION IN AN ORGANIZATIONAL SETTING:
A STUDY OF ELECTRONIC MAIL**

By

Linlin Ku

A DISSERTATION

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ABSTRACT

IMPACTS OF INTERACTIVITY FROM COMPUTER-MEDIATED COMMUNICATION IN AN ORGANIZATIONAL SETTING: A STUDY OF ELECTRONIC MAIL

By

Linlin Ku

This study addresses the influence of the use of computer-mediated communication (CMC) systems in an organizational setting on communication outcomes. Coexistent with earlier modes of communication, CMC systems have the potential to improve organizational communication. A theoretical model is proposed to suggest that interactive use of CMC systems can increase organizational members' ability to process information, which will have positive effects on their performance. A series of variables regarding antecedent factors (task requirements, accessibility of individuals, media experience and skills requirements), usage patterns (amount and purposes of use), interactive use and outcomes (information load, user satisfaction and decision quality) is incorporated into the model.

For the purpose of hypothesis and model testing, electronic mail was chosen as the focus of this study. Survey data (n=191) were collected from a Maryland telecommunications company during April, 1992. Confirmatory factor analyses determined whether expected dimensions actually measured the underlying constructs. Correlations tested the significance of hypotheses. Path analyses then were conducted to examine direct and indirect effects of use of electronic mail on information load, user satisfaction and decision quality.

The results showed that among the antecedent factors, time pressure, accessibility of individuals and skill requirements were strong predictors of amount and purposes of electronic mail use. Both geographical dispersion and time pressure had direct, positive effects on communication in different directions. Frequent use increased interactive use and communication in different directions. Task-related uses showed strong, positive effects on interactive use. Socioemotional use decreased downward and diagonal communication, whereas bulletin board use increased horizontal communication. Interactive use generally increased upward communication.

Regarding communication outcomes, information load was influenced by time pressure, amount of use and upward communication. How satisfied users were with electronic mail depended on how accessible they were to others, how skillful they were with the system, and how interactively they used the system. Interactive use increased access to quality information and participation in the decision-making process. Interactive use had positive but weaker effects on decision effectiveness and acceptance. Finally, interactive use had no effect on decision speed.

To my parents

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CHAPTER 1: INTRODUCTION

As more and more microcomputers are adopted by organizations, they have begun to influence the way organizational members process information and the way they communicate with one another. In particular, the computer increases organizational members' ability to gather, organize, monitor, filter and disseminate information. Organizations that can effectively process information will increasingly have a competitive edge (Huseman & Miles, 1988). The computer can also provide organizational members with more opportunities to actively participate in the communication process. Computer-mediated communication (CMC) systems allow the restructuring of organizational communication. Changes in organizational communication may affect individual and group performance in organizations.

This dissertation proposes a conceptual model of examining usage of CMC systems in an organizational setting, the communication process brought about by using those systems and their communication outcomes. Usage includes amount and purposes of use, whereas the CMC process is characterized by interactivity. Communication outcomes refer to information load tolerance, user satisfaction and decision quality. Electronic mail is selected as an example of CMC systems to test the model.

Organizational Communication

It is evident that communication is a fundamental part of most organizational activities. For example, in a study of top executives, Mintzberg (1973) found that 75% of their time was spent in communication activities. Mintzberg's findings are consistent with other studies of how managers spend their time.¹ Communication can be defined as the

exchange of information and inference of meaning among organizational members (O'Reilly & Pondy, 1979). Information is shared to reach mutual understanding (Rogers & Rafaeli, 1985). Since communication is pervasive in organizations, it serves a variety of task and nontask-related functions. Information is exchanged not only to coordinate activities and to establish authority and responsibility, but to express feelings and maintain relations (O'Reilly & Pondy, 1979).

The need for information exchange is influenced by environmental factors, namely, complexity and uncertainty. As complexity and uncertainty increase, so does the need for information processing and exchange at individual, group and organizational levels (Galbraith, 1973; O'Reilly & Pondy, 1979; Tushman & Nadler, 1978). The greater the complexity, the more information organizational members have to process. With increased uncertainty, strategies must be devised for effective information processing to reduce uncertainty. From this information processing perspective, O'Reilly and Pondy (1979) argue that:

organizations must accurately sense their relevant environments, process information to make decisions, and coordinate and control subunits and members. Information and the capability to receive, process, and communicate it in a timely and accurate manner become crucial organization functions. (p. 125)

Effective information processing can reduce distortion and increase accuracy in the communication process. Since communication is essential to organizational processes and activities, it is directly related to organizational outcomes. Effective organizational communication should lead to greater user satisfaction and better decision making (O'Connell, 1988; O'Reilly, Chatman & Anderson, 1987).

Computer-Mediated Communication

Communication via computers provides new opportunities to improve organizational communication. Computer-mediated communication can be defined as interactive communication facilitated with the help of computers (Culnan & Markus, 1987; Rice & Rogers, 1984). The most salient characteristic of computer-mediated communication is interactivity, which will be discussed in detail in the next chapter. Computer-mediated communication resembles interpersonal communication in terms of its interactive nature, but information is exchanged with some type of computer and electronic communication equipment intervening. It also has certain characteristics of mass communication; for example, messages can be quickly disseminated from one or a few individuals to a large, geographically dispersed audience. However, the nature of computer-mediated communication is different from that of mass communication in many ways. The model of the communication process proposed by Shannon and Weaver (1949) cannot properly explain the interactive nature of computer-mediated communication.² For example, the distinction between a sender and receiver is blurred. Users of CMC systems can be referred to as participants (Rogers, 1986). In addition, participants decide the content of messages and no single message is at the center of CMC process. It is no longer possible to distinguish an initial message from feedback to that message (Rogers & Rafaeli, 1985). The convergence model by Rogers (1986) and the information exchange model by Heeter (1986) are just two examples of scholarly efforts to reconceptualize the communication process.

As compared with mass communication, computer-mediated communication is said to be a process of "demassifying" mass communication (Rogers, 1986). Unlike mass media, CMC systems are usually used among a limited number of participants, e.g., two or more individuals or small groups of people. A feature of demassification is that

participants in the communication process are more homogeneous. In the case of computer-mediated communication, each participant may receive quite different information from the same system. Demassification also implies a shift of control over communication systems from the message producer to the message consumer because participants can be senders as well as receivers (Rogers, 1986).

When compared with interpersonal communication, computer-mediated communication is likely to "massify" interpersonal communication (Rice & Steinfield, 1990; Steinfield & Fulk, 1988a; 1988b). New applications of CMC systems provide opportunities for broadcasting messages by individuals to large numbers of recipients, either in the home or organizational setting. Although CMC broadcasting cannot match the scope of television network broadcasting, Steinfield and Fulk (1988a, 1988b) expect CMC broadcasting to be more popular as microcomputers proliferate and network connection becomes more common at organizational, regional, national and international levels.

Either demassification or massification suggests the capacities of CMC systems to provide one-to-one, one-to-few, one-to-many and small group communication. In the information age CMC systems are likely to complement traditional media so managers can process information more effectively. While the human capacities of speaking, listening, reading and writing are likely to remain constant, the capacities of computers are increasing exponentially (Huseman & Miles, 1988). Huseman and Miles (1988) argue that "managers who can best use the computer's ability to scan, filter, organize, process, maintain, and distribute information will be the more successful managers in the information age" (p. 184).

Defining CMC Systems

CMC systems included in the discussion are directly related to human communication via computers; therefore, systems that treat human communication as a component of a multifunction information service, e.g., online information retrieval systems and videotex systems, are excluded. CMC systems encompass electronic mail, voice mail, computer conferencing and electronic bulletin boards. Some systems have the capacity of supporting several types of communication such as electronic mail, bulletin boards and computer conferencing. These systems are described below.

Electronic mail. Electronic mail refers to the use of shared computer systems via computer networks to distribute text-based messages between individuals and groups of people. It commonly involves the creation of a message as a distinct file on a microcomputer or terminal, the transmission of that file to one or more "mailboxes" for storage, and the subsequent display of that file by recipients at their convenience. Many systems provide additional features such as retrieving, editing, filing, managing, forwarding, and printing messages (Miller & Vallee, 1980; Rice, 1980; Rice & Borgman, 1983; Rice & Love, 1987; Steinfield, 1986a). However, there is no guarantee that the recipient will read the message and answer it.

Voice mail. Voice mail systems provide the same capacities as the electronic mail systems, with input and output in the form of speech as opposed to text. The sender can enter commands to the processor by using standard push-button telephones and leave audio messages. The sender's speech is then digitized, transmitted and stored in one or more recipients' voice mailboxes for subsequent replay. The system keeps track of who has picked up (heard) the message and who has not. Individuals who do not have voice

mailboxes can still leave a voice message to any user, similar to answering services (Heeter, 1986; Senn, 1987; Steinfield, 1986a).

Computer conferencing. Computer conferencing refers to access to shared computer files, using remote terminal equipment and telecommunications networks, by specified groups of individuals separated by time or space. Unlike electronic mail, computer conference systems store only one copy of each entry; thus an entry is not a discrete file transmitted to another user, but an addition to a multiaccessible data base. Entries are automatically saved according to the tasks of a computer conference. Computer conferencing, either synchronous or asynchronous, facilitates interactive group communication where face-to-face interaction is either impossible or undesirable (Miller & Vallee, 1980; Phillips, 1983; Rice, 1980; Rice, 1984b; Rice & Borgman, 1983; Svenning & Ruchinskis, 1984).

Electronic bulletin boards. Electronic bulletin board systems involve the posting of announcements, messages or comments to shared files. Comments posted on a bulletin board are normally intended for all users of a particular system. Unlike electronic mail or computer conferencing, electronic bulletin boards are considered an emerging mass medium (Rafaeli, 1986a). These systems afford the use of microcomputers to transmit files to and from the host computer, sending private messages, and synchronous communication among those who are connected (Rafaeli, 1986a; Rogers, 1986; Steinfield, 1986a).

The major technical equipment of CMC systems consists of microcomputers, telecommunications networks, digital transmission and storage, and terminals. The unique

technical equipment creates a combination of characteristics and functions unavailable or less salient in mass and interpersonal media.

CMC Systems in Organizations

The information processing perspective provides a basis for examining impacts of CMC systems in organizations. CMC systems aid in processing information in many ways. They can provide organizational members with access to information not otherwise available, or not available quickly enough before a decision is made. They also facilitate rapid dissemination of information, through which ideas can be exchanged in a more timely, accurate fashion. Increased accessibility of information brought about by the computer will result in an increased load of information that organizational members have to handle on a daily basis. Organizational members will then have to improve their ability to process information so as not to experience information overload. Although use of CMC systems increases information load, they have the capability of monitoring, filtering and controlling information. Thus, computers can help organizations cope with environmental complexity and uncertainty, if individuals learn to use them to handle information more efficiently and effectively.

Use of CMC systems can also increase communication at all levels of an organization. Specifically, they facilitate communication in four distinct directions: downward, upward, horizontal and diagonal (Ivancevish & Matteson, 1990). They provide more communication channels and encourage direct communication between the top and bottom. Bypasses become more common in organizational communication activities. It should be noted that increased communication is not the same as increased understanding of the meaning of information (Rice, 1980), and therefore increased communication does not necessarily improve communication.

CMC systems exist side-by-side with more traditional communication media in organizations. Use of CMC systems tends to reduce use of telephone and memos (Rice & Case, 1983) and eliminates the need for meetings on some occasions. However, they don't seem to replace traditional media. They are more likely to be used in combination with other new communication technologies such as fax and/or traditional media to engage in communication activities and to make decisions.

Scholars (e.g., Huseman & Miles, 1988; Rogers & Rafaeli, 1985) claim that the nature of communication is a product of the technology of the medium, which has been manifested by the proliferation of new communication technologies. This is what Rogers and Rafaeli (1985) termed "technology-dependency." CMC systems have capabilities not found in traditional media. These new capabilities have the potential to redefine the communication process. For example, CMC systems can keep accurate accounts of communication. The availability of transcripts can keep track of positions of each participant as consensus evolves (Culnan & Markus, 1987). They can also be used as documents of conversation to reduce misunderstanding and clarify positions for certain issues. They keep track of actions taken after decisions are made. Further, CMC systems are asynchronous. Asynchronicity permits the accessibility, retention and retrieval of messages over extended periods of time. It also allows participation of multiple, geographically dispersed users in the communication process. Asynchronous communication fosters interaction among users who are not on coordinated schedules (Rogers & Rafaeli, 1985).

Purpose of Study

The purpose of this dissertation is to examine the impacts of CMC systems on organizational communication and performance. Coexistent with earlier modes of

communication such as face-to-face, telephone and memos in organizations, CMC systems have the potential to improve communication. In particular, if organizational members learn to take advantage of capacities of CMC systems, they will increase their ability to process information, which will have positive effects on their performance. A conceptual model of the CMC process and its communication outcomes will be proposed. At the center of this model is interactive use of CMC systems, which is expected to increase communication at all directions. Outcomes of interactive use include information load and work and decision quality. In addition, interactive use will be influenced by amount and purposes of use, which are affected by characteristics of the system, task requirements and personal characteristics. Previous studies of each component of the model will be reviewed in Chapter 2. The proposed model is then presented with hypotheses in Chapter 3. Chapter 4 explains the process of data collection and methods employed to test the hypotheses and model. Chapter 5 reports results of data analysis and Chapter 6 discusses implications and limitations of the results.

Endnotes

¹ See R. Rice & J. H. Bair (1984), for a compilation of studies of time allocation of managers and professionals to communication activities.

² For criticisms of assumptions of previous communication theory and research, see E. M. Rogers (1986), p. 198.

CHAPTER 2: REVIEW OF LITERATURE

A great deal of research on CMC systems has been generated. Much of this research focuses on how new communication technologies are chosen to exchange information and the impacts of such choices on performance.¹ This chapter focuses on previous studies that are advantageous in building a model of the CMC process and is organized in four parts. Previous studies on developing the concept of interactivity will be discussed, followed by studies on usage of CMC systems and factors influencing CMC usage. Studies on impacts of CMC systems will then be reviewed.

Interactivity

As defined earlier, computer-mediated communication is interactive communication facilitated with the help of computers. Interactivity is the most salient characteristic of CMC systems, which allow increased interactivity among users or between users and information. Interactivity, thus, is a variable characteristic of the communication process. Scholars have tried to define what interactivity is. Rafaeli (1986b, 1988) approached interactivity in terms of the responsiveness or conversationality of participants in communication systems, the degree to which a communication exchange resembles human discourse. The assumptions of his approach include: 1) human discourse is the standard; 2) communication systems can be measured and compared in terms of how responsive participants can be; and 3) interactivity is a desired quality in the communication process. He defined interactivity as "an expression of the extent that in a given series of communication exchanges, any third (or later) transmission (or message) is related to the degree to which previous exchanges referred to even earlier transmissions" (Rafaeli, 1988). This definition recognizes three pertinent levels: two-way (noninteractive), reactive (or

quasi-interactive), and fully interactive communication. Two-way communication is present as soon as messages flow bilaterally, whereas reactive communication requires that messages are created based upon a previous message. Fully interactive messages can be based upon the way previous messages relate to even earlier ones. For full interactivity to occur, communication roles need be fully interchangeable. Fully interactive communication processes are ones that are closest in form to human discourse; however, ultimate interactivity is only an ideal. Rafaeli's (1988) attempt was to apply interactivity to a wide range of communication settings: from unmediated face-to-face to mass-mediated systems.

Rafaeli (1986b) argued that the computer is likely to add interactivity to communication settings. The computer can increase interactivity by involving more participants in the communication process, by increasing audiences to certain messages, and by offering diverse sources. To examine the impacts of added interactivity, Rafaeli (1986b) conducted an experiment. Three groups of subjects were asked to complete three different versions of an opinion questionnaire. Group 1 was given a conventional paper form, Group 2 used a reactive computerized version, and Group 3 used an interactive computerized version. Findings showed that subjects in Group 3 were more likely to perceive that they were having a conversation with the creator of the questionnaire than those in other two groups. Although Group 3 also perceived its computerized version to be more interactive than did Group 2, the latter was the one that considered the reactive computerized version more efficient in asking people's opinions. No differences in feelings about the different media were presented. It seems that interactivity is a valid concept with tangible effects, but it was considered as a unidimensional concept.

Rice (1987) focused on interactivity from the amount of participant control over a communication process. Interactivity was defined as the degree to which participants in

communication processes have the ability to respond quickly, exchange roles and terminate their mutual discourse. Fully interactive media allow participants to exchange roles, that is, a response from A to B is based on B's response to A's initial message (Bretz, 1983; Rice, 1984a). This idea of exchangeability of roles is consistent with the concept of responsiveness defined by Rafaeli.

Williams, Rice, and Rogers (1988) subsequently provided a clearer definition of interactivity, "the degree to which participants in a communication process have control over, and can exchange roles in, their mutual discourse" (p. 10). Control indicates the extent to which a participant can choose the timing, content, and sequence of a communication act, while exchange of roles refers to the ability of person A to take the position of person B and thus to perform B's communication acts, and vice versa. Mutual discourse is the degree to which a given communication act is based upon a prior series of communication acts.

In their attempt to establish a conceptual framework for understanding electronic message systems (EMS), Miller and Vallee (1980) identified six classes of concepts associated with human communication networks as crucial to a formal representation of EMS: 1) channels, 2) networks, 3) messages, 4) nodes, 5) operations, and 6) protocols. Dimensions characterizing human communication via EMS are defined for each class of concepts. Dimensions that are of particular relevance to the concept of interactivity include channel feedback and network connectivity. From the user's point of view, the channel is defined as "the totality of function by which users can manage the flow of information to and from themselves" (Miller & Vallee, 1980). Channel feedback refers to the degree to which a channel provides for the recipient of a message to respond immediately and to

affect the source of the message, whereas network connectivity indicates the degree to which participants in communication processes have access to other participants.

Heeter (1986) clearly stated that interactivity is a multidimensional concept. She integrated the work of Rice (1984c), Paisley (1983), and Rafaeli (1986b) and developed six dimensions of interactivity. The first refers to the complexity of choice available (Rice, 1984c), the extent to which users are provided with a choice of available information. When more choice of content is available, the audience for any particular content at any particular time is smaller. Users accessing the same message on an electronic bulletin board at the same time are likely to be a few. The second dimension concerns the effort users must exert. Heeter extends Paisley's (1983) mathematical definition to include all possible effort a user must exert to access information. For example, electronic mail users must exert more effort using complex computer commands than people sitting down to write a letter by hand. The third dimension involves responsiveness of a medium to the user, as defined by Rafaeli (1986b). The fourth dimension refers to the potential of a medium to monitor system use (Heeter, 1986). For example, messages on electronic bulletin boards are computer-recorded; information exchange can be monitored on a continuous basis. The fifth dimension involves ease of adding information, the degree to which users can add information to the system that a mass audience can access (Heeter, 1986). Users of computer conferencing and electronic bulletin boards can easily add information to the data base. The final dimension refers to the extent to which a medium facilitates interpersonal communication between specific users. For example, synchronous computer conferences and electronic bulletin boards have the potential to facilitate interpersonal communication by allowing users to participate concurrently.

Heeter (1986) attempted to apply the concept of interactivity to a series of media systems. She identified 53 intrapersonal, interpersonal, integrated and mass media and then operationalized the six dimensions of interactivity. Values were assigned to each of the dimensions for each medium. According to Heeter's evaluation of CMC systems, they acquired a moderate level of interactivity, compared to other kinds of media. Within the CMC systems, bulletin boards offered the most choice of content (the highest average number of messages available to a user), while computer conferencing required the most efforts to begin accessing a system and to select information once a connection is established. Voice mail and synchronous computer conferencing were rated more responsive than others, and all CMC systems, except synchronous computer conferencing, offered continuous system monitoring. It would be easier to add information by using computer conferencing and bulletin boards, while synchronous computer conferencing offered the most potential to facilitate interpersonal communication because it's instantaneous and without delay in exchanging information. One advantage of Heeter's concept of interactivity is that it is intended to be applied to a wide range of media. When a new kind of communication technology becomes available, researchers can easily assess its degree of interactivity. However, her concept focused more on the media characteristics and conditions under which interactive media are used than on the communication process brought about by interactive media. Further, the values assigned to the six dimensions for each medium were arbitrary and no empirical evidence supported the variations of those dimensions across media.

Interactivity is an inherent quality of the communication process, not just a quality of the computer itself (Rafaeli, 1986b). Interactivity is a desired quality of communication systems under the assumption that increased interactivity leads to more effective communication and more satisfaction to participants in communication processes (Rogers,

1986). CMC systems have the potential to increase interactivity among organizational members who have already been communicating with one another interactively. They can determine the timing, content and sequence of their communication by creating, adding, editing, deleting, retrieving, and indexing messages at any time they would like. In doing so, organizational members not only develop new communication behaviors, but establish new communication partners. New communication behaviors are developed due to more participant control over the communication process, while new communication partners are a result of more access to other participants. Previous research (Heeter, 1986; Miller & Vallee, 1980; Rafaeli, 1986b, 1988; Rice, 1987; Williams et al., 1988) clearly suggests that interactivity should be conceptualized in terms of the amount of control participants have over the communication process. Participant control includes how quickly feedback can be received, how responsive a communication process is, how easily a participant can enter inputs, and how often a participant can terminate a communication process. Moreover, interactivity should be conceptualized as the degree of access participants have to other participants (Miller & Vallee, 1980). Access refers to the extent to which individuals can be linked together by a medium, so they can be sources as well as receivers of information during a communication process. The above discussion leads to the formulation of the following dimensions for interactivity:

Immediacy of feedback, the extent to which feedback can be received quickly (Rice, 1987).

Responsiveness, the extent to which any third or later message in a given series of communication exchanges is associated with the way previous exchanges are related to even earlier ones (Rafaeli, 1986b).

- *Source diversity*, the extent to which information can come from more than one source. This dimension is derived from Rafaeli's (1986b) and Rogers' (1986) discussion of characteristics of CMC.

Communication linkages, the extent to which individuals can be linked together by a medium during the communication process. Research results show increased communication linkages after the introduction of CMC systems (Rice, 1984b; Rice & Case, 1983) because CMC systems allow more communication linkages and users have attempted to communicate with other users by taking advantage of this feature.

γ *Equality of participation*, the extent to which participants can express their opinions at any time during the communication process. Research findings suggest users can participate in the communication process more equally via CMC systems than face-to-face (Johansen, Vallee, & Spangler, 1979; Kerr & Hiltz, 1982; Kiesler, Siegel, & McGuire, 1982). This is because people can enter comments at any time by using CMC systems and avoid the influence of nonverbal cues.

φ *Ability to terminate*, the extent to which a participant is able to stop the communication process (Rice, 1987).

As demonstrated in Table 1, all four types of CMC systems allow diverse sources of information, a number of communication linkages, more equal participation, and more ability to terminate the communication process. Feedback can be received quickly through all types of CMC systems except bulletin boards for their public nature. For the same reason, bulletin boards are low in responsiveness. Other three types of CMC systems afford higher degree of responsiveness, but the actual degree of responsiveness is largely determined by how interactive participants are in the communication process.

Usage of CMC Systems

One conceptualization of usage of CMC systems is the number of messages an individual sends or receives. Results differ among companies. For example, e-mail users

Comparisons of dimensions of interactivity for CMC systems
Table 1

CMC System				
Interactivity	Electronic Mail	Voice Mail	Computer Conferences	Bulletin Boards
Immediacy of feedback	fast	fast	fast	slow
Responsiveness	*	*	*	low
Source diversity	many	many	many	many
Communication linkages	many	many	many	many
Equality of participation	high	high	high	high
Ability to terminate	high	high	high	high

*: Level of responsiveness depends largely on situations and how the systems are used.

in an information processing management company reported sending an average of nine messages per work week to other people (Steinfeld, Jin, & Ku, 1988). Users in an office equipment firm sent two but received 24 messages per day (Sproull & Kiesler, 1986). Rice and Shook (1990a) found that 40% of people in an insurance company who had voice mailboxes had never sent a message. The remaining 60% sent or received no more than two messages per day. Rafaeli (1986) studied patterns of an electronic bulletin board use by students and faculty in a university. Nearly three-fourths reported using the board more than once a week and 61% reading more than half of the messages on the board. Usage of computer conferencing systems is more complex. Patterns of use can include: number of items composed, received, and exchanged privately and within a group (Hiltz & Turoff, 1981).

Usage can also be conceptualized as the time an individual spends online. In a study of e-mail use in an aerospace company (Rice & Shook, 1988), users reported spending an average of 38 minutes per day using the system. University administrators spent roughly the same amount of time using their accounts (Rice & Case, 1983). In their study of e-mail use in a commercial bank, Nyce and Groppa (1983) found middle managers and non-managers spent about 39 minutes per day using the system, while senior managers spent only 23 minutes. Rafaeli (1986) found that 62% users of a university electronic bulletin board spent 5 to 15 minutes each time on the board. For computer conferencing, time can be measured in terms of length of each session or total time spent over a period of time (Hiltz & Turoff, 1981).

In addition, rich insights into media use were gained from examining the purposes for which people use CMC systems. The attempt was to determine how prospective users choose among alternative media based upon the attributes of the media and the nature of

communication activity to be supported (Steinfeld, 1986a). This media characteristics perspective is illustrated by two bodies of work: the theories of social presence and information richness.

Short, Williams and Christie (1976) focused on the psychological aspect of using telecommunications media and proposed the concept of social presence, the extent to which users perceive others to be psychologically present when interacting with others through a communication medium. Dimensions of social presence of a medium included sociability, sensitivity, warmth and personalness. Several media were arrayed along a single continuum according to their social presence. Face-to-face communication was perceived to have the greatest social presence, followed by television, multispeaker audio, telephone audio and business letters. The most salient reason for differentiating media in terms of social presence is the restriction of conveying nonverbal cues on some media (Rice & Williams, 1984). The telephone, for example, cannot convey visual cues and physical proximity as personal conversations do. CMC systems would be considered as low in social presence due to their lack of nonverbal cues and physical proximity.

The social presence theory postulates that users not only perceive social presence inherent in different media, but recognize the needs of communication tasks for media of different levels of social presence. Users will attempt to match the needs of communication tasks with the appropriate medium. They will prefer media affording greater social presence when tasks require interpersonal interaction, e.g., bargaining and negotiation. CMC systems, therefore, are appropriate only for tasks involving simple information exchange. However, the social presence theory has been widely criticized for the lack of a clear definition and its unidimensional nature (Albertson, 1980; Fulk, Steinfeld, Schmitz, & Power, 1987; Heeter, 1986; Rice & Williams, 1984).

Daft and Lengel (1984, 1986) approached the issue of media choice from the managerial perspective. They premised that richness of medium should be matched to needs of message for effective communication and proposed a theory called information richness. Communication media were characterized as rich or lean based upon 1) the speed of feedback, 2) the channels employed, 3) personalness of the source, and 4) the form of language employed. According to the media richness hierarchy (Lengel & Daft, 1988), face-to-face is the richest medium, with the capacity of immediate feedback, multiple cues, personal focus and natural language. Interactive media such as telephone and CMC systems are the second richest media, followed in order of decreasing richness by personal static media (memos, letters and tailored computer reports) and impersonal static media (flyers, bulletins and generalized computer reports). Thus, face-to-face communication was considered suitable for ambiguous tasks such as bargaining and resolving conflict, whereas CMC systems were appropriate for less ambiguous, routine information exchange. Information richness resembles social presence, in that both assume that physical characteristics of a medium limit the amount and kind of information that can be conveyed, and that users objectively evaluate the characteristics of tasks and media and choose the combination most closely matching task requirements (Fulk et al., 1987).

Rice (1987) used the idea of bandwidth to include the diversity of cues that a particular medium can transmit. These cues are physical distance, kinesic gestures, paralinguistic tone (e.g., tone, volume and rate), verbal meaning, numeric data and social presence. The idea of bandwidth is closely related to the theories of social presence and information richness. Typically, face-to-face is considered to possess higher bandwidth, whereas CMC systems are low-bandwidth media.

To understand how managers choose a medium to effectively communicate a message, other scholars have focused on the capacity of different media to convey symbolic meaning (Feldman & March, 1981; Trevino, Daft, & Lengel, 1990; Trevino, Lengel, & Daft, 1987). Trevino and colleagues (1987, 1990) adopted a *symbolic interactionist* (Blumer, 1969; Stryker & Statham, 1985) perspective. The premises are that an organization is a dynamic meaning system and the foundation of organizational member interaction is a shared system of meaning, which is established primarily through language and social cues. In ill-defined situations, organizational members will look to others for cues and feedback to reduce ambiguity and create symbols that establish new organizational meanings.

By using the symbolic interactionism framework, Trevino and colleagues (1990) proposed that managerial media choices will be influenced by three types of variables: 1) the equivocality of the message, 2) contextual determinants, and 3) the symbolic cues conveyed by the medium itself. They argued that managers should be able to match message equivocality with media richness for effective communication. An effective manager will choose a rich medium to communicate equivocal messages to capture message complexity, but use a lean medium to communicate unequivocal messages to save time and prevent excessive cues. Consequently, managers who are insensitive to the richness of media cannot perform effectively. Contextual determinants, including geographical dispersion, time pressure and access to the technology, will be discussed in the next section. Finally, managerial media choice may carry symbolic cues beyond the literal message content. In a study of 65 managers in 11 organizations, Trevino and colleagues (1987) found that managers chose face-to-face to signal a desire for teamwork, to build trust, or to convey informality. Both face-to-face and telephone symbolized urgency and

showed personal concern. Electronic mail was thought to show compliance with protocol, or to convey lack of urgency and lack of importance.

In a recent study of media choice in organizations, Sitkin, Sutcliffe and Barrios-Choplin (1992) combined the media characteristics perspective (research on the capacity of media to convey data) and symbolic interactionist perspective (the capacity of media to convey and manifest meaning). Regarding the capacity of electronic messaging systems to convey data, they can be chosen for timely feedback, use of natural language and personalized messages. In addition, electronic mail can be chosen as a symbol of using the latest equipment to signify leading-edge procedures. Universal access to the system also illustrates status equality. Electronic mail can be chosen as a conduit of symbolic meaning such as permitting ready access to an entire user group regardless of schedules (e.g., asynchronous communication). They further argued that media choice based upon data carrying capacity would be influenced by task requirements, organizational constraints and personal characteristics, whereas media choice based upon symbol carrying capacity would be affected by normative factors.

Previous studies usually concluded that CMC systems (low bandwidth) are appropriate for routine tasks, but not for socioemotional purposes because of their impersonal nature (Daft & Lengel, 1984; Heimstra, 1982; Picot, Klingenberg, & Kranzle, 1982; Short et al., 1976; Trevino et al., 1987, 1990). However, other studies have noted frequent socioemotional content in computer-mediated communication (Danowski, 1982; Kiesler, Siegel, & McGuire, 1984; Phillips, 1983; Rice & Love, 1987; Steinfield, 1985, 1986b; Steinfield et al., 1988). Electronic mail, for instance, has been used for taking a break from work, keeping in touch with others, and organizing social activities (Steinfield, 1985, 1986b). Phillips (1983) described emotional dimensions of computer conferences

by focusing on aspects such as humor, expressions of disagreement, spontaneity of comments and use of anonymous comments. Previous research on computer conferencing also suggests that computer conferencing may not be as satisfactory as face-to-face for bargaining and resolving conflicts. However, it may be selected for very embarrassing or conflicting situations to minimize interpersonal interaction (Rice, 1980).

Specifically, two dimensions of purposes of use emerged from Steinfield's (1985, 1986b) studies of e-mail systems: task-related use (e.g., coordinating project activities and scheduling meetings) and socioemotional use (e.g., taking a break from work and keeping in touch). He found that those two dimensions could be influenced by different factors. Task-related uses were best explained by access to the system, the existence of coworkers in other locations (geographical dispersion), and a positive orientation toward CMC systems, particularly perceived utility. On the other hand, socioemotional uses were best explained by demographic and organizational role variables.

In a subsequent study, Steinfield and colleagues (1988) suggested four dimensions of electronic mail use: routine use such as information exchange, complex use such as negotiating and bargaining, social use such as keeping in touch, and bulletin board use such as broadcasting information requests. Those four dimensions are particularly helpful in conceptualizing purposes of use. While task-oriented uses range from routine information exchange to complex negotiating, the socioemotional dimension recognizes frequent socioemotional content in CMC. The bulletin board dimension is based upon the ability of CMC systems to broadcast messages to a large number of users. Implied within those four purposes of use is that organizational members choose a CMC system to communicate a particular message both for its ability to transmit data and for its ability to carry the symbolic meaning meant by the sender.

Factors Influencing Usage of CMC Systems

How individuals use CMC systems can be influenced by a number of factors that come into play in any organizational context. The media characteristics perspective, including social presence and media richness, provides abundant evidence of antecedent factors associated with usage of CMC systems. These factors include: 1) objective features of the system, namely, access to CMC systems, 2) objective task requirements, namely, geographical dispersion, 3) perceived task requirements, including time pressure and task analyzability, and 4) personal characteristics, including accessibility of individuals to others, media experience, and skill requirements. They are discussed below.

1. Access to CMC systems

Access to CMC systems is the most often discussed objective feature of CMC systems (Culnan & Markus, 1987; Kerr & Hiltz, 1982). Access refers to whether individuals have their own terminals, accounts or other equipment (e.g., a telephone set), or must share them with other users or go to another location. Organizational members may have different levels of access to CMC systems, which may directly affect their media selection and use. Research results suggest that access to the system is a major determinant of media choice (Rice & Case, 1983; Steinfield, 1986b). In a study (Hiltz, 1980) of small groups of professionals, an electronic information exchange system was designed to enhance communication among geographically dispersed small research communities. This system supports electronic messaging, conferencing and bulletin boards. After three months 19% of the users reported inconvenient access to a terminal to be a reason of limited use of the system. Rice and Shook (1988) employed five measures of terminal accessibility: 1) physical distance to a terminal, 2) percent of time terminal was being used by others, 3) the number of people sharing the terminal, 4) the general difficulty of access, and 5) the number of minutes one usually had to wait to get a terminal. Both physical

distance and difficulty of access were significantly correlated with usage of electronic messaging systems, whereas the three other accessibility variables were not related to usage.

2. Geographical dispersion

Geographical dispersion, considered as an objective communication task requirement, refers to the extent to which communication partners are physically separated. This variable has been shown to correlate with use of telecommunication media in general, and electronic mail in particular (Steinfeld, 1986b; Steinfeld et al., 1988). Steinfeld and Fulk (1986) found that geographical dispersion significantly influenced media choice. Managers who were geographically separated from their communication partners were more likely to use electronic mail, regardless of message equivocality. Here, message content played a less important role when managers faced with such constraint. One study (Steinfeld et al., 1988) showed mixed results. Geographical dispersion was found to be positively related to social and bulletin board uses of electronic mail, but negatively related to routine and complex task-related uses.

3. Perceived task requirements

There are two types of perceived task requirements that may affect the use of CMC systems. One is time pressure, the extent to which a quick decision must be made (Steinfeld et al., 1988). When time pressure is involved, individuals tend to be more favorable to face-to-face and telephone interactions than text-based media such as electronic mail and computer conferencing (Steinfeld & Fulk, 1986). However, other studies showed different results. One study (Steinfeld, 1986b) found no relationships between time pressure and task-related use of electronic mail. Nor was time pressure related to

social use. Another study (Steinfeld et al., 1988) found that time pressure is positively related to number of e-mail messages sent and complex e-mail uses.

The other is task analyzability, the extent to which tasks involve application of objective standard procedures and do not require novel solutions (Perrow, 1967). Following the work of Daft and Lengel (1984, 1986), perceived analyzability of tasks is one critical task attribute with implications for communication media choices. According to the media richness and symbolic interactionist theories, CMC systems are expected to be appropriate for tasks that are highly analyzable since less equivocal messages would be involved with highly analyzable tasks, which can be handled more efficiently on CMC systems. Research results have provided some support for this hypothesis. Task analyzability has been shown to be positively related to routine use and negatively related to complex use of electronic mail (Steinfeld et al., 1988). Voice messaging was also used more often in less analyzable task environment (Rice & Shook, 1990a).

4. Accessibility of individuals to others

Accessibility of individuals to others is the extent to which individuals are willing to make themselves available for communication (Marcus, 1987). This factor involves three variables: 1) frequency of checking electronic mailboxes, 2) a perceived need to communicate (Rice, 1984b), and 3) the availability of information that can be exchanged with others (Markus, 1987). The first variable is based upon personal efforts made to check messages or system features. For some systems, individuals have to log on to see if there are any messages in their mailboxes. Some other systems are equipped with flashing lights, indicating incoming messages. The other two variables are related to individual's perceptions of how important it is to seek communication partners and exchange information by using a CMC system. Generally, media affording asynchronous

communication are less constrained by these two variables since individuals have more options in terms of the time and content they are willing to communicate.

5. Media experience

Media experience is the length of time an individual has used a particular medium on a regular basis (Steinfeld et al., 1988). Media experience may encourage use of CMC systems. When people become more familiar with the system, they tend to build it into their daily work. Schmitz (1986) found that government employees were more likely to increase their use of e-mail systems when they had more experience with the systems. Steinfield (1986b) found that media experience was positively related to task-related use of electronic mail, but not social use. In another study (Steinfeld et al., 1988), media experience was found to be directly related to number of messages sent and complex use. Media experience was also directly related to perceived ease of use, which contributed to more usage of electronic mail, including number of messages sent and complex, social and bulletin board uses. Experience with CMC systems may affect the patterns of CMC use. For example, experienced users of electronic mail are more likely to apply it to a wider range of uses (Rice & Case, 1983). It may be that experienced users have acquired the skills necessary to use the system.

6. Skill requirements

Skill requirements indicate the level of skill required for a user to process information over a medium. It also means the level of knowledge necessary to use a medium. For example, users of computer conferencing may need extensive training in typing skills and using specific commands, while telephone conversation or television viewing requires minimal level of skill. Users who acquire better typing skills and more knowledge of the particular CMC system in use will feel more comfortable using it to

communicate with others. In his study of government employees, Schmitz (1986) found that typing skills were a determinant of police officers' and managers' use of electronic mail. This same study also found that how satisfied police officers and professionals were with the training they received was a determining factor of e-mail use.

Impacts of CMC Systems

While CMC systems facilitate organizational communication in all directions, a direct result is changes in the load of information with which organizational members have to deal. It is most likely that they will have to learn to handle an increased load of information. Moreover, CMC systems can be used to perform tasks and make decisions. Users may develop perceptions about how satisfied they are with the CMC systems available to them and how these systems can influence the quality of their work and their decisions. These impacts are discussed below.

1. Communication in all directions

Olson and Lucas (1982) proposed that the communication functions of automated office systems can lead to an increase in the total volume of communication due to ease of sending messages. Field studies have identified new and increased communication linkages among individuals as a result of using CMC systems (Rice, 1984b). For example, Rice and Case (1983) found an increase in new communications among university administrators within 2 to 5 months after the introduction of an electronic messaging system. Of the administrators surveyed 43% reported new communication partners whom they previously did not communicate with over the phone or in writing. Users of a Swedish electronic messaging and conferencing system reported that 50% of the messages they sent and 75% of the messages they received were new communications that

would not otherwise occur without the system (Palme, 1981). Hiltz (1984) found that system use increased both formal and informal communication among users.

Furthermore, studies have indicated the ability of CMC systems to influence directions of intraorganizational communication. Increased upward and downward communication was found within a department in which an electronic messaging system was used (Lippitt, Miller, & Halamaj, 1980) and across departments (Rice & Case, 1983). Leduc (1979) studied an integrated office system with the capacity of messaging in a Canadian telephone company at two time periods, 6 and 22 months after the system was installed. At Time 1 communication over the system occurred primarily between supervisors and their respective subordinates (vertical communication). But by Time 2 everyone had tried to use the system to communicate with everyone else. Communication had approached an "all-channel" structure.

2. Information load

Increased communication raises the question of whether CMC increases a user's ability to process information or results in information overload. Information load refers to the rate and complexity of information inputs to an individual, whereas information overload indicates that an individual cannot process information as rapidly as it is received, or as rapidly as the individual would like to process it (Huseman & Miles, 1988). Feldman and March (1981) argued that organizational use of information is highly symbolic because it is embedded in social norms. Their observations indicated that much of the information used to justify a decision is gathered after the decision is made and much of the information gathered by individuals bears little decision relevance. From this perspective, CMC systems may be used more for symbolic than for functional purposes because of the high visibility and political consequences of complex systems. If that is the case, users may not

be able to handle increased information more efficiently. In addition, intensive interaction with a large number of participants results in many simultaneous and perhaps redundant discussions, meetings and other activities that may go beyond individual's normal coping abilities (Kerr & Hiltz, 1982). Certain increased information may not be desired by users (Rice & Case, 1983). Increased load of information may also be redundant in nature, or irrelevant to the issue at hand (Hiltz & Turoff, 1985). Hiltz & Turoff (1985) summarized situations where individuals have experienced information overload. They might 1) fail to respond to certain inputs, 2) respond inaccurately, 3) respond to inputs later as time permits, 4) systematically ignore (e.g., filter) certain features of the input, or 5) quit in extreme cases.

Huseman and Miles (1988) noted that users were more likely to experience information overload during early stages of computer implementation. Hiltz and Turoff (1985) argued that individuals perceived information overload to peak at intermediate level of use when they had yet to develop screening skills. However, when the computer is properly used, it can extend people's ability to manage information overload. Users with more media experience are less likely to experience information overload by using filtering mechanisms such as searching by keyword and filtering by topic (Hiltz & Turoff, 1985). *

3. User satisfaction

User satisfaction refers to the extent to which users believe CMC systems available to them meet their communication needs, including task and non-task related needs (Ives, Olson, & Baroudi, 1983). User satisfaction is a perceptual, subjective outcome of CMC. It concerns perceived worth, utility, and ease of use of CMC systems. Bailey and Pearson (1983) defined computer user satisfaction as the sum of a user's positive and negative reactions to a set of factors. A user's feeling about the computer is placed somewhere

between a "most positive" and a "most negative" reaction. They interviewed a group of middle managers and came up with a list of 39 factors associated with satisfaction. Each factor consisted of four bipolar adjective pairs. For example, the factor "reliability of the output information" was measured by the following four pairs of adjectives: consistent vs. inconsistent, high vs. low, superior vs. inferior, and sufficient vs. insufficient. The most important factors included accuracy, timeliness, reliability, and relevancy of the output information and user's confidence in the systems, all related to the utility of services provided by the computer.

Early studies of networks showed that participants in communication networks were more satisfied than isolates (O'Reilly & Pondy, 1979). Satisfaction was also found to be positively related to the opportunity to initiate communication (O'Reilly & Pondy, 1979). These results are consistent with later studies of use of particular communication systems. For example, Hiltz (1980) studied how satisfied small groups of professionals were after they had used an electronic information exchange system for six months. Users reported the system to be stimulating, good, fun, friendly and easy, but didn't always find it efficient. Results also showed that the amount of use was positively related to satisfaction.

Research on perceived media characteristics offers useful insights. Researchers have tried to identify perceived characteristics of CMC systems and to evaluate the extent to which particular characteristics affect task-related and social use of CMC systems. The most relevant characteristics are perceived utility and ease of use. Perceived utility refers to people's expectations about the effectiveness of using a communication channel. It is usually measured by pairs of bipolar adjectives such as useful vs. useless, effective vs. ineffective, efficient vs. inefficient, fast vs. slow and convenient vs. inconvenient.

Perceived utility has been shown to be positively related to use (Svenning & Ruchinskas, 1984; Steinfield, 1986b; Steinfield et al., 1988). In particular, perceived utility was found to be an important predictor of both task-related and social uses of electronic mail (Steinfield, 1986b). Steinfield and colleagues (1988) later confirmed the influence of perceived utility on social uses, but failed to establish relationships between perceived utility and task-related uses. The concept of perceived utility can be extended to measure user satisfaction. It can be conceptualized as the extent to which any outcomes derived from CMC the user perceives to be useful (Bailey & Pearson, 1983).

Next, a person is more likely to use a communication system if it is perceived to be easier to use (Svenning & Ruchinskas, 1984; Steinfield, 1986b; Steinfield et al., 1988). Ease of use can be conceptualized as ease or difficulty with which a user may act to use the capability of a CMC system to perform tasks or meet other communication needs (Bailey & Pearson, 1983). It is usually measured by adjectives such as easy vs. difficult, simple vs. complex and comfortable vs. uncomfortable. Ease of use has been associated with the number of messages sent through electronic mail (Steinfield et al., 1988) and task-related e-mail use (Steinfield, 1986b).

Davis, Bagozzi, and Warshaw (1989) proposed a technology acceptance model, which posits that perceived usefulness and perceived ease of use are primary factors explaining computer acceptance behaviors. Data were collected from a group of business students and results showed that perceived usefulness was a major determinant and perceived ease of use was a significant secondary determinant of people's intentions to use computers. On the other hand, Ettema (1985) studied uses of a videotex system by measures of system-monitored use and self-reported use. Neither was found to be related to user satisfaction.

In addition to perceived characteristics of CMC systems, user satisfaction can be examined in terms of how users associate their work quality with their CMC use. In a study of an integrated health information system by Rice and Aydin (1991), people's attitudes toward the system were conceptualized as utility (the extent to which the computer system is worth the time and effort required to use it), ease of use (degree of ease of performing the department's work), and work quality (the extent to which the system has changed the quality of the department's work). Rice and Case (1983) found that after the introduction of an office information system, including electronic messaging, university administrators reported improvements of their quality of work. In their study of e-mail use in an aerospace company, Rice and Shook (1988) found that amount of use was positively related to work quality. Work quality can be conceptualized as people's evaluation of their task performance facilitated by using CMC systems.

4. Decision quality

As stated earlier, if communication of information is essential to organizational processes, it should be directly related to organizational outcomes such as performance. At the individual level, accurate and relevant information improves decision making, and within groups, accuracy and openness of communication improves group effectiveness (O'Reilly & Pondy, 1979). If CMC systems are intended for improving communication, usage alone will increase the likelihood of improving performance. Either individual or group decisions can benefit from use of CMC systems.

Much of the literature on impacts of CMC systems directs its attention to the ability of CMC systems to influence the decision-making process as a result of increased communication among organizational group members. Most studies in this area use

controlled experiments in which researchers give subjects certain problems to solve and collect measures of group interaction and performance (e.g., Hiltz, Johnson, & Rabke, 1980; Hiltz, Johnson, & Turoff, 1986). Subjects are usually assigned to solve two different types of problems: routine information exchange and complex negotiating and bargaining. Typically, results from face-to-face interaction are compared with those from CMC to determine if CMC is more efficient or effective, or at least as efficient as face-to-face through which a decision is made. This type of study assumes that face-to-face interaction is desired by users, whenever possible. Generally, participants in face-to-face meetings appears to be more satisfied and reach consensus more quickly (e.g., Steinfield & Dick, 1989). A group leader is also more likely to emerge in face-to-face meetings. However, these differences did not occur uniformly for different sets of problems. Furthermore, differences in decision quality usually do not exist, either for different types of problems or for different modes of communication.

Decision quality can be conceptualized as communication outcomes, determined by comparing end results to previously decided, objective standards, or perceived goals of communication. The former usually involves simple information exchange. An example is the use of a ranking problem. Group members individually rank all listed items according to degree of importance to the problem at issue, and then engage in discussion with other members to reach a consensus. They individually rank all items again, and the results are compared with expert ranking of the items. Fewer differences between individual and expert ranking indicate better decision quality. Steinfield and Dick (1989) conducted an experiment to determine if results from face-to-face meetings and from desktop video conferences would be different for simple information exchange. They did not find any differences in decision quality for the two types of meetings. On the other hand, for more complex situations, e.g., bargaining, group members may have different interpretations of

the outcome when no specific solution is sought. For example, in a follow-up of Steinfield and Dick's study, Ku (1990) failed to find differences in a negotiation situation and concluded that desktop video conferencing could be as effective as face-to-face when complex decisions were involved.

The emphasis on information and its importance in organizations is reflected in two research traditions: message flow and decision making. Message flow research examines the flow of messages in organizations and the resulting organizational and individual effects (O'Reilly & Pondy, 1979). On the other hand, the decision making research has provided insights about how information is used to make decisions. For example, Janis and Mann (1977) provided examples of how decision makers selectively sought out information that would support a favored position or deliberately avoided negative information. Both research traditions have relied on various types of laboratory experiments, making generalizing findings difficult.

O'Reilly, Chatman and Anderson (1987) outlined differences in laboratory and field settings. In laboratory studies, decision makers usually have little experience with the task and little vested long-term interests. They focus on a limited set of cues, operate with artificial time pressures and are not concerned with interpersonal relationships. The information cues are typically written, quantifiable, and relevant only to the tasks at hand. There are limited in number of cues without interpersonal content. In contrast, decision makers in field studies are concerned with multiple cues, experienced, and responsible for long-term results. They have to deal with interpersonal relationships and operate with a variety of time pressures. The information cues are verbal, qualitative, relevant to a large set of tasks, and are socially and culturally embedded.

In their efforts to integrate the two research approaches, O'Reilly, Chatman and Anderson (1987) proposed that organizational contextual factors affect decision makers' acquisition and use of information. Organizational contextual factors include structure, incentive systems, group norms and task requirements. They argued that the quantity and quality of information decision makers use will affect the quality of decisions. Bias towards information seeking has been well-documented. Instead of seeking out the most accurate information, decision makers rely on more accessible sources (O'Reilly, 1982). They also have a tendency to search for more information than can be effectively processed (Feldman & March, 1981), but seek out information that supports a desired position and avoid unsupported information (Janis & Mann, 1977). When presented with a large quantity of information, decision makers appear to interpret and evaluate the information differently (e.g., Hawkins, Hoffman, & Osborne, 1978; Kilmann & Mitroff, 1976). These findings suggest that decision quality is directly related to the quality of information necessary to support decision-making. With the introduction of advanced computer systems to organizations, decision makers have to process more information than ever. The quality of information becomes even more crucial.

In addition to information quality, the quality of decisions can be affected by a variety of factors. Organizational decisions are the outcome of a dynamic process to achieve a desired goal. They are "an organizational response to a problem" (Ivancevich & Matteson, 1990, p. 516). According to Ivancevich and Matteson (1990), the process can involve the following steps: 1) establishing specific goals and objectives and measuring results, 2) identifying problems, 3) developing alternatives, 4) evaluating alternatives, 5) choosing an alternative, 6) implementing the decision, and 7) controlling and evaluating. At each step, decision makers have to process, interpret and evaluate a great deal of information. In particular, the development, evaluation and selection of alternatives would

benefit from exchange of information among a moderate to large number of experts (Huber, 1990). Thus, the number of people participating in the decision-making process as a source of information may influence decision quality.

To facilitate the decision-making process, participants can achieve a consensus about how alternatives should be developed and evaluated and which alternatives should be selected. When people have agreed upon how a problem should be solved, they may be more willing to accept the results (Ivancevich & Matteson, 1990). This seems obvious for group decision making. For individual decision making, some kind of consensus may have to be reached among coworkers or between supervisors and subordinates since individual decision making is not an isolated process in organizations and will affect other individuals and groups.

Another aspect of decision making is the time it takes to make a decision. Differences in decision speed can be expected for various types of decisions. Generally, there are two types of decisions: programmed and nonprogrammed (Ivancevich & Matteson, 1990). Programmed decisions deal with problems that are repetitive and routine. These decisions can be handled through rules, standardized procedures and the organizational structure that develops specific procedures for handling them. In contrast, nonprogrammed decisions require judgment, tolerance for ambiguity and creative problem solving. Making nonprogrammed decisions is expected to require more time than making programmed decisions.

Decisions have to be evaluated in terms of their effectiveness. Decision effectiveness can be determined by comparing the actual results with the objective or perceived goal of decision making (Ivancevich & Matteson, 1990). It seems that

effectiveness of programmed decisions can easily be evaluated, while evaluating nonprogrammed decisions is more complex and long-term results should be taken into account. Sometimes the outcome of a decision is unexpected or perceived differently by different people, and decision makers would have to determine if such outcome is still effective.

Acceptance of final decisions among organizational members will facilitate the implementation of the decisions. Decision acceptance remains an understudied area, since most studies on decision making focus on how managers make decisions. Once a final decision is made, acceptance is assumed. This study argues that acceptance should not be an assumption, but a factor to be examined.

It is argued that decision quality should be a multidimensional concept. It should be conceptualized to include information quality, participation, consensus, speed, effectiveness and acceptance. These dimensions are expected to be mutually associated.

Information quality, the extent to which information necessary to evaluate decision alternatives is available, timely, accurate, comprehensive, and relevant (Huber, 1990; Rice & Williams, 1984).

Participation, the number of people participating as information sources in the decision-making process (Huber, 1990).

Decision consensus, the extent to which decision makers can reach an agreement ((Ivancevich & Matteson, 1990; Rice, 1984b).

Decision speed, the time it takes to make a programmed or nonprogrammed decision (Huber, 1990).

Decision effectiveness, the extent to which a decision meets the perceived goals of communication to solve a problem (Ivancevich & Matteson, 1990).

Decision acceptance, the extent to which a final decision can be accepted by individuals.

Endnotes

- ¹ Steinfield did an extensive review of research on CMC systems. See Steinfield (1986a).

CHAPTER 3: A MODEL OF CMC USAGE, INTERACTIVE USE AND OUTCOMES

As suggested in previous chapters, uses of CMC systems are likely to affect organizational communication and task performance. Usage alone does not necessarily lead to improved communication and better performance. An argument to be made here is that performance can be improved when CMC systems are used interactively. Since organizational communication activities are directly related to task performance, improved communication can help people perform their jobs more effectively. Interactive use of CMC systems has the potential to minimize barriers to effective communication by giving individuals more control over the communication process and more access to other people. For example, information overload can be overcome by actively monitoring and filtering information. When sources of information are diversified, the influence of each source may be reduced, enabling people to select more accurate and relevant information. Since users are invisible, interpersonal interaction can be handled through the computer to avoid negative effects of nonverbal cues in highly embarrassing or conflicting situations.

Interactivity is usually conceptualized as a characteristic of a communication system (e.g., Miller & Vallee, 1980), or a characteristic of a communication process (e.g., Rafaeli, 1986b, 1988; Williams et al., 1988), or a combination of both (e.g., Heeter, 1986). Increased interactivity among users can be brought about by CMC systems. The actual degree of interactivity is determined not only by the kind of system people use, but how people use it. In other words, people should be willing to use a CMC system interactively. A second argument is that interactivity is a desired quality of communication patterns that vary among individuals. Interactivity is, then, conceptualized from the user's perspective.

This conceptualization of interactive use embraces earlier concepts of interactivity. It implies that users recognize the interactive capacity of a particular communication system. It also implies that participants in a communication process would be willing to communicate interactively. Interactive use can be examined rigorously by observing how people communicate with one another.

Based upon previously cited literature and the conceptualization of interactive use, a conceptual model is formulated, examining the effects of interactive use of CMC systems on organizational communication and task performance. This model starts with the assumption that organizational members use all kinds of media available to them to make sense of their environments, to perform tasks, and to make decisions. They are willing to take control over the way they communicate with others, and by doing so, they can perform tasks more effectively through improved communication. They also prefer numerous communication linkages so as to keep in touch with others. Extended communication linkages make seeking other people's opinions and feedback easier. As they are already using more traditional media, e.g., telephone and memos, for interpersonal communication, the availability of new communication technologies, e.g., CMC systems, promises new communication activities.

Further, it is assumed that users recognize the characteristics of particular communication systems and, accordingly, will choose one or more appropriate systems to communicate with others or perform tasks. Although media characteristics can be recognized, users may weight different characteristics differently. Thus, the same media can be chosen for different reasons under different circumstances. It is also assumed that users are able to recognize the symbolic meaning conveyed by particular systems.

Similarly, the symbolic meaning conveyed by a system can be understood differently by the sender of a message and the receiver.

The model consists of four parts: antecedent factors, usage of CMC systems, interactive use of CMC systems and communication outcomes. Usage of CMC systems can be affected by a number of factors. Specifically, system features, objective and perceived task requirements, and personal characteristics will influence usage. These factors can also have indirect effects on how interactive individuals use CMC systems. For example, if an individual is not convinced of the need to use CMC systems to communicate, this will not encourage frequent use, which, in turn, will not establish new communication linkages for individuals.

How interactive organizational members use CMC systems can be influenced by amount and purposes of use. For instance, more frequent use of CMC systems provides individuals easy and frequent access to others and more control over communication activities. Purposes of use and interactive use are two distinctive constructs; the former taps characteristics of communication content and the latter characteristics of communication process. Thus, complex use can be noninteractive whereas bulletin board use can be interactive. For example, while negotiating, participants may be slow in giving feedback to others and unresponsive. While using electronic mail as bulletin boards, people may respond quickly and enter comments easily.

Interactive use of CMC systems will foster communication in all directions, and an increased load of information is expected. Results from interactive use also include how satisfied users are with the system and whether the quality of their work and decisions has been improved.

Figure 1 provides a model indicating the role of interactive use in evaluating communication activities and work and decision quality. Formally stated, the propositions derived from this model are:

P1: CMC usage is a function of a) objective system features--access to CMC systems, b) objective task requirements--geographical dispersion, c) subjective task requirements--time pressure and task analyzability, and d) personal characteristics--accessibility of individuals to others, media experience, and skill requirements.

P2: Interactive use of CMC systems is a function of CMC usage.

P3: Communication in all directions is a function of: a) usage and b) interactive use of CMC systems.

P4: Information load is a function of communication in all directions.

P5: User satisfaction is a function of interactive use of CMC systems.

P6: Decision quality is a function of interactive use of CMC systems.

Research Hypotheses

To examine this model in the organizational context, a series of research hypotheses will be derived from the propositions stated above. For the purpose of hypothesis testing, only one CMC system will be investigated since all four types of CMC systems share variance to a certain degree. Electronic mail is selected as the focus of this study for several reasons. First, user behaviors can be observed in more natural settings. Next, electronic mail currently is probably the most commonly used CMC system in organizations. Third, the technical equipment of many electronic mail systems allows conferences and bulletin board uses, while voice mail is an audio version of text-based electronic mail. The following sections specify the research hypotheses.

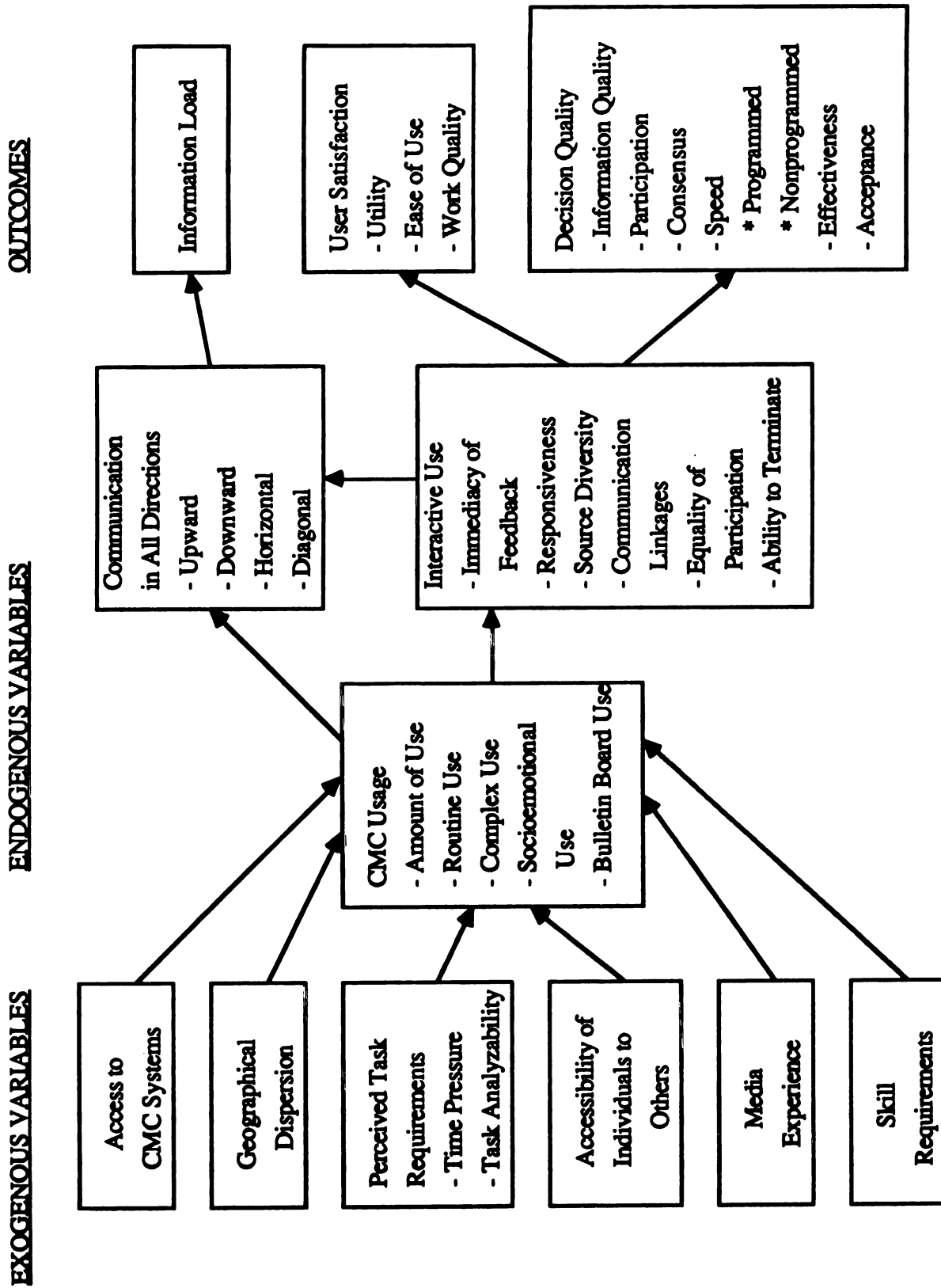


Figure 1: A Model of Uses of CMC Systems and Their Communication Outcomes

1. Factors influencing usage of electronic mail

Access refers to whether individuals are provided with their own terminals, or have to share them with others or go to another location. It also means whether users have their own accounts, or have to share them with others. Electronic mail systems usually require a higher degree of access than interpersonal or mass media, so organizations can encourage more use by providing its members easier access.

H1.1.1: Access to electronic mail will be positively related to amount of use.

H1.1.2: Access to electronic mail will be positively related to routine use.

H1.1.3: Access to electronic mail will be positively related to complex use.

H1.1.4: Access to electronic mail will be positively related to socioemotional use.

H1.1.5: Access to electronic mail will be positively related to bulletin board use.

Coworkers geographically dispersed are more likely to use electronic mail to fulfill communication needs (Steinfeld, 1986b; Steinfeld et al., 1988), in addition to using other forms of media. On the other hand, communication partners working on the same floor can easily engage in face-to-face or telephone conversations.

H1.2.1: Geographical dispersion will be positively related to amount of use.

H1.2.2: Geographical dispersion will be positively related to routine use.

H1.2.3: Geographical dispersion will be positively related to complex use.

H1.2.4: Geographical dispersion will be positively related to socioemotional use.

H1.2.5: Geographical dispersion will be positively related to bulletin board use.

Two types of perceived task requirements affect electronic mail use: time pressure and task analyzability. When time pressure is involved, individuals tend to prefer face-to-face or telephone interactions to text-based media such as electronic mail or memos (Steinfeld & Fulk, 1986). Research findings show that task analyzability is positively

associated with routine use and negatively with complex use of electronic mail (Steinfeld et al., 1988). Since perceived task requirements are not typically related to nontask-related uses, no hypotheses regarding socioemotional and bulletin board uses will be proposed.

H1.3.1: Time pressure will be negatively related to amount of use.

H1.3.2: Time pressure will be negatively related to routine use.

H1.3.3: Time pressure will be negatively related to complex use.

H1.3.4: Task analyzability will be negatively related to amount of use.

H1.3.5: Task analyzability will be positively related to routine use.

H1.3.6: Task analyzability will be negatively related to complex use.

When there is a perceived need to communicate (Rice, 1984b) and when information that can be exchanged with others is available (Markus, 1987), an individual becomes more available for communication. Accessibility of individuals to others, thus, leads to more use of electronic mail.

H1.4.1: Accessibility of individuals will be positively related to amount of use.

H1.4.2: Accessibility of individuals will be positively related to routine use.

H1.4.3: Accessibility of individuals will be positively related to complex use.

H1.4.4: Accessibility of individuals will be positively related to socioemotional use.

H1.4.5: Accessibility of individuals will be positively related to bulletin board use.

As users of an electronic mail system become more experienced, they tend to apply it to a wider range of uses and incorporate it into their work on a daily basis. Thus, electronic mail use becomes more prevalent. Steinfeld and colleagues (1988) found that experience in using electronic mail systems is positively related to amount of use and complex use.

H1.5.1: Media experience will be positively related to amount of use.

H1.5.2: Media experience will be positively related to routine use.

H1.5.3: Media experience will be positively related to complex use.

H1.5.4: Media experience will be positively related to socioemotional use.

H1.5.5: Media experience will be positively related to bulletin board use.

Individuals may require more than typing skills to become interested in using an electronic mail system. For example, they should acquire some knowledge of the system features and training for using particular commands. Less skillful users tend to rely more on other media that require fewer skills to perform their communication tasks than more skillful ones.

H1.6.1: Skill requirements will be positively related to amount of use.

H1.6.2: Skill requirements will be positively related to routine use.

H1.6.3: Skill requirements will be positively related to complex use.

H1.6.4: Skill requirements will be positively related to socioemotional use.

H1.6.5: Skill requirements will be positively related to bulletin board use.

2. Usage of electronic mail and interactive use

Research findings show an increased number of communication partners and new intraorganizational communication networks after the implementation of electronic messaging and conferencing systems (Palme, 1981; Rice, 1984b; Rice & Case, 1983). It is reasonable to expect a positive relationship between usage and interactive use.

Researchers have identified both task and nontask-related CMC usage. Although CMC (low bandwidth) systems were thought to be most suitable for simple information exchange than for complex tasks such as negotiation (Daft & Lengel, 1984; Heimstra,

1982; Picot, Klingenberg, & Kranzle, 1982; Short et al., 1976; Trevino, Lengel, & Daft, 1987), frequent nontask, socioemotional uses of CMC systems were found (Danowski, 1982; Kiesler et al., 1984; Rice & Love, 1987; Steinfield et al., 1988).

In a cross-organizational study of research scientists who used a computer conferencing system, Hiltz (1984) found that system use leads to increased communication with colleagues both on and off the network. System members appear to "become indirect links between the online and off-line worlds" (Hiltz, 1984, p. 153). It can be inferred from the findings that both task and non-task related uses of electronic mail systems contribute to more interactive use. As indicated in Table 1, electronic bulletin boards involve a lower degree of interactivity; thus, bulletin board use of electronic mail systems will be unlikely to encourage interactive use. No relationships will be hypothesized for the two. Separate hypotheses will not be stated for each of the six dimensions of interactive use, but hypotheses which follow will be tested for each of those dimensions.

H2.1: Amount of use will be positively related to interactive use.

H2.2: Routine use will be positively related to interactive use.

H2.3: Complex use will be positively related to interactive use.

H2.4: Socioemotional use will be positively related to interactive use.

3. Usage of electronic mail, interactive use, and communication in all directions

Field studies provide evidence about the ability of electronic media to affect the direction of intraorganizational communication. Researchers found both increased upward (Lippitt et al., 1980; Rice & Case, 1983), downward (Lippitt et al., 1980) and horizontal (Rice & Case, 1983) flow of communication after the implementation of electronic messaging systems. Bypasses (diagonal communication) make top executives more accessible to nonmanagers. Frequent users will feel more comfortable using the systems to

perform all kinds of tasks (Dutton, Fulk, & Steinfield, 1982), which will, in turn, lead to increased flow of communication in all directions. The relationships between bulletin board use and communication in all directions are much less obvious and will not be hypothesized. The four distinctive directions of communication (upward, downward, horizontal and diagonal) will not be stated in the hypotheses, but each will be tested.

H3.1: Amount of use will be positively related to communication in all directions.

H3.2: Routine uses will be positively related to communication in all directions.

H3.3: Complex use will be positively related to communication in all directions.

H3.4: Socioemotional use will be positively related to communication in all directions.

H3.5: Interactive use of electronic mail will be positively related to communication in all directions.

4. Communication in all directions and information load

It is expected that individual information load increases as the flow of communication becomes heavier. Information load includes the rate and complexity of information inputs to individuals. An increased amount of communication does not necessarily lead to information overload if individuals can effectively process information. Whether individuals can handle increased amount of information depends on system design features and individual abilities to filter out undesired message flows (Hiltz & Turoff, 1985). More experienced system users generally have more knowledge of system features and greater ability to use filtering and other mechanisms.

H4.1: Communication in a diversity of directions will be positively related to information load.

H4.2: More experienced system users are less likely to experience information overload than less experienced users.

5. Interactive use and user satisfaction

People are expected to be more satisfied when they have more control over the communication process. Electronic mail systems allow more control over the communication process; if people use electronic mail, along with more traditional media, to interact with other people, they will be more satisfied with the systems and outcomes.

H5.1: Interactive use will be positively related to perceived utility of electronic mail.

H5.2: Interactive use will be positively related to perceived ease of using electronic mail.

H5.3: Interactive use will be positively related to perceived work quality.

6. Interactive use and decision quality

Use of CMC systems can aid not only in identifying problems and opportunities, but in more access to information that is more accurate and comprehensive (Huber, 1990). Bailey and Pearson (1983) used the quality of information as part of a technique for measuring computer user satisfaction. It is reasonable to expect that more access to quality information enables managers to evaluate decision alternatives more effectively.

In many organizational decisions, the development, evaluation, and selection of alternatives would benefit from sharing information among a variety of participants. Assuming that the number of people involved in a decision-making process is largely determined by the time and effort it takes for people to communicate, Huber (1990) posits that more people would serve as sources of information because computers can greatly reduce the effort required for people separated in time and physical proximity to exchange information (Culnan & Markus, 1987). Research findings show that CMC systems are

useful in sharing information (Rice, 1984b) and lead to an increase of overall amount of communication (Palme, 1981; Rice & Case, 1983; Sproull & Keisler, 1986).

Research findings generally suggest that it is less likely to reach consensus in computer conferencing than in face-to-face meetings (Kerr & Hiltz, 1982). This, Rice (1984b) reasoned, might be partially due to time limits and technical factors. He expected the problem to improve when participants have gained more experience. In a review of 10 experimental group decision support system (GDSS)¹ studies by Dennis, George, Jessup, Nunamaker and Vogel (1988), three studies found that GDSS supported groups were less likely to achieve consensus; however, the results have been inconsistent for other studies. Considering using electronic mail to make decisions, it may become more difficult to achieve consensus due to more people entering comments at any time and less pressure on people to agree with others unless a leader emerges or initial consensus is reached (Rice, 1984b).

Findings about the time required to make a decision have been inconsistent for different types of electronic meeting systems. While several studies found that it took more time to make decisions for computer conferencing and GDSS groups than for face-to-face groups (Dennis et al., 1988; Rice, 1984b), others found no such differences (Dennis et al., 1988; Steinfield & Dick, 1989). However, self-report data on the use of electronic mail usually show increased speed of decision-making. Managers reported that electronic mail saved them several hours a week, mostly by eliminating unreturned phone calls and internal correspondence (Nyce & Groppa, 1983), and helped them make decisions more quickly (Crowford, 1982). Different types of decisions may have some influence on decision speed (Ivancevich & Matteson, 1990). It seems that CMC systems can help people make programmed decisions more quickly in that an established procedure has been developed

for people to follow. As for nonprogrammed decisions, there are no predetermined procedures for handling them and they usually require creativity in problem solving. More input, thus, will be required from organizational members to develop alternatives, and increased flow of communication will require people to take more time to evaluate and choose alternatives.

Regarding decision quality, studies have found that computer conferencing is at least as effective as face-to-face meetings (Ku, 1990; Dennis et al., 1988; Steinfield & Dick, 1989), and more effective in other experimental conferencing settings (Dennis et al., 1988). In case and field studies of GDSS groups, participants unanimously reported greater effectiveness than groups without the aid of computers (Dennis et al., 1988). Although it may take longer time to make decisions via CMC systems, the quality of decision-making may improve due to increased availability of quality information, more input from participants, and possibly more alternatives to choose from, as a result of more frequent information sharing.

Field and case studies of GDSS groups have reported more consistent decision satisfaction than experimental studies. GDSS users in field and case studies reported high satisfaction of the meeting outcome; final decisions were well supported by participants (Dennis et al., 1988). Some participants in GDSS and computer conferencing reported higher satisfaction with meeting outcomes (Dennis et al., 1988), whereas others reported no differences (Ku, 1990; Steinfield & Dick, 1989; Dennis et al., 1988). It seems that when more information is shared among more people in the decision-making process and when people feel less pressured into agreeing with others, final decisions will be more easily accepted once they are made.

H6.1: Interactive use of electronic mail will be positively related to information quality.

H6.2: Interactive use of electronic mail will increase the number of people participating as sources of information in the decision-making process.

H6.3: Decision makers will be less likely to achieve consensus when they use electronic mail more interactively than others.

H6.4.1: More interactive use of electronic mail will reduce the time required to make a programmed decision.

H6.4.2: More interactive use of electronic mail will increase the time required to make a non-programmed decision.

H6.5: More interactive use of electronic mail will improve decision effectiveness.

H6.6: More interactive use of electronic mail will increase the likelihood of a decision being accepted by individuals.

The above research hypotheses are presented in Table 2. Amount and purposes of electronic mail use are hypothesized to contribute to more interactive use, which, in turn, is expected to lead to increased information load and better work and decision quality.

**Hypothesized Relationships among Electronic Mail Usage, Interactive Use
and Communication Outcomes**
Table 2

Independent Variables	Dependent Variables	Hypothesized Relationship	Hypothesis
Access to electronic mail	Amount of use	+	H1.1.1
"	Routine use	+	H1.1.2
"	Complex use	+	H1.1.3
"	Socioemotional use	+	H1.1.4
"	Bulletin Board use	+	H1.1.5
Geographic dispersion	Amount of use	+	H1.2.1
"	Routine use	+	H1.2.2
"	Complex use	+	H1.2.3
"	Socioemotional use	+	H1.2.4
"	Bulletin Board use	+	H1.2.5
Time pressure	Amount of use	-	H1.3.1
"	Routine use	-	H1.3.2
"	Complex use	-	H1.3.3
Task analyzability	Amount of use	-	H1.3.4
"	Routine use	+	H1.3.5
"	Complex use	-	H1.3.6
Accessibility of individuals to others	Amount of use	+	H1.4.1
"	Routine use	+	H1.4.2
"	Complex use	+	H1.4.3
"	Socioemotional use	+	H1.4.4
"	Bulletin Board use	+	H1.4.5
Media experience	Amount of use	+	H1.5.1
"	Routine use	+	H1.5.2
"	Complex use	+	H1.5.3
"	Socioemotional use	+	H1.5.4
"	Bulletin Board use	+	H1.5.5
Skill requirements	Amount of use	+	H1.6.1
"	Routine use	+	H1.6.2
"	Complex use	+	H1.6.3
"	Socioemotional use	+	H1.6.4
"	Bulletin Board use	+	H1.6.5

Table 2 (Cont'd)

Independent Variables	Dependent Variables	Hypothesized Relationship	Hypothesis
Amount of use	Interactive use ¹	+	H2.1
Routine use	"	+	H2.2
Complex use	"	+	H2.3
Socioemotional use	"	+	H2.4
Amount of use	Communication in all directions ²	+	H3.1
Routine use	"	+	H3.2
Complex use	"	+	H3.3
Socioemotional use	"	+	H3.4
Interactive use ¹	Communication in all directions ²	+	H3.5
Communication in all directions ²	Information load	+	H4.1
Media experience	Information overload	-	H4.2
Interactive use ¹	Perceived utility	+	H5.1
"	Perceived ease of use	+	H5.2
"	Perceived work quality	+	H5.3
Interactive use ¹	Information quality	+	H6.1
"	Decision participation	+	H6.2
"	Decision consensus	-	H6.3
"	Programmed decision time	-	H6.4.1
"	Nonprogrammed decision time	+	H6.4.2
"	Decision effectiveness	+	H6.5
"	Decision acceptance	+	H6.6

¹ The six dimensions of interactive use--immediacy of feedback, responsiveness, source diversity, communication linkages, equality of communication and ability to terminate--were not stated in the hypothesis form, but significance tests will be done for each dimension.

² The four directions of communication--upward, downward, horizontal and diagonal--were not stated in the hypothesis form, but significance tests will be done for each direction.

Endnotes

¹ A GDSS provides computing, communication and decision aids to support group decision making. A basic GDSS has e-mail capabilities, designed primarily to improve the rate of information flows in the decision process. The second-level GDSS supplement the basic technology with a variety of decision support tools such as decision trees and budget allocation models. The third level GDSS imposes structure on communication patterns. They control the timing and pattern of information exchange. They can also restrict communication linkages among group members. For detailed descriptions of GDSSs, see DeSanctis and Gallupe (1987). In a study by Straub and Beauclair (1988), 19% of the firms surveyed used computer conferencing for decision making and 10% had implemented decision rooms.

CHAPTER 4: METHODOLOGY

This chapter describes data collection and analysis procedures used to test the model and hypotheses outlined in Chapter 3. These hypotheses seek to assess the relationships of interactive e-mail use with its communication outcomes in an organizational setting. A profit-oriented company that uses an e-mail system would be selected for data collection. Because interactive use of electronic mail, not its early adoption stage, is at the center of this study, this company should have that e-mail system installed for more than a year. Also, it was felt that a survey within the corporation would be the most appropriate method to collect data for the purposes of this study. Although this is a case study of electronic mail, it attempts to identify factors influencing interactive use and examine effects of interactive use, which potentially facilitates comparisons with previous and future studies of electronic mail systems.

Field Site and Sample

Personal contacts were made with Hughes Network Systems (HNS), a subsidiary of Hughes Aircraft, to explore the possibility of using it as a study site. HNS supplies U.S. and international markets for satellite networks and digital communications technologies. Headquartered in Germantown, Maryland, it employs more than 1400 people. HNS's major development and manufacturing facilities are located in Germantown, San Diego, California, and Milton Keynes, U.K. It uses an in-house VAX/E-MAIL system, which connects all branch offices and plants. This e-mail system is connected to Internet so employees may have international communication partners. However, this system is used predominantly for internal purposes. Other kinds of CMC systems are also in use: a voice mail system with a limited number of users and an

electronic bulletin board. It also uses a teleconferencing system to hold meetings among offices and with clients.

The company agreed to a survey of e-mail users after a research proposal (see Appendix 1) was submitted to senior management. The researcher visited the company in mid-December, 1991, and conducted several interviews to get general ideas about the system features and communication environment. Results of that visit were documented in a site visit report (see Appendix 2). It was decided that the headquarters would be the sole study site because approximately 80% of employees work at the headquarters. Further, because the response rate of a recent company survey was 25%, it was decided that all e-mail users at the headquarters would be included in the sample to assure an adequate response rate. A total of 953 e-mail users were identified. Each user has his/her own account number and password.

As described in Chapter 3, this survey investigates eight groups of variables, including antecedent factors, e-mail usage, interactive use, communication in all directions, information load, user satisfaction, decision quality and background information. Since electronic mail is used in conjunction with other media to perform tasks, it is necessary to examine how employees normally interact with one another regardless of the form of communication they choose. Thus, variables measuring interactive use consist of two parts: 1) variables measuring general interaction among organizational members regardless of the medium they choose to use; and 2) variables measuring how they use electronic mail to communicate with one another. The following section describes how these variables are operationalized.

The Survey Instrument

A questionnaire was developed to assess the interrelationships between use of electronic mail and its communication outcomes. Operational definitions and response categories of all variables are described below.

1. Factors influencing usage of electronic mail

Access to electronic mail. This variable addresses the issue of different levels of access. Since no user has to share an account with others, the central concern is various levels of access to terminals. The respondents were asked if they had their own terminals on their desk or in their office. Those who indicated having their own terminals were asked to identify the number of people (from 0 to 3 or more) sharing a terminal with them. The respondents who didn't have terminals were asked if the nearest terminals they could use to access electronic mail were located near their desk/office, not near their desk/office but on their floor, on another floor but in the same building, or in another building.

Geographical dispersion. The respondents were asked whether the people they regularly dealt with at work (at least once a week) were located on the same floor as they were, on another floor of this building, in another building in the same city, in another city, or in another country. They were instructed to check all answers that applied to their situation.

Perceived task requirements. There are two dimensions of perceived task requirements: time pressure and task analyzability. Time pressure was measured by whether their job involved time pressure, crises and urgent matters, and the need for rapid decision, whereas task analyzability was measured by whether their job involved well-defined subject matter, tasks with clearly defined outcomes, and tasks with standard

procedures. The response categories for all six items were: not at all, little, some, much and very much.

Accessibility of individuals to others. Accessibility of individuals was measured by three variables. First, the respondents were asked how often they checked their electronic mailbox during a typical work day (once a day, twice or more a day, or don't always check). Next, they were asked how much they agreed with the following two statements: I really need to use electronic mail to communicate with other people; and I don't always have enough information to communicate with other people through electronic mail. The response categories for these two items ranged from 1 meaning strongly disagree to 5 meaning strongly agree, with neutral placed in the middle.

Media experience. The respondents were asked to fill in the month and year they became regular users of electronic mail or "never" did. Regular use means sending or receiving at least a couple of messages per week on the average.

Skill requirements. Skill requirements were measured by a user's typing skills and the knowledge necessary to use the specific electronic mail system. The respondents were asked if their typing skills were very slow, adequate but slow (several fingers), slow touch typing, moderate touch typing, or rapid, accurate typing. Three statements (from 1 meaning strongly disagree to 5 meaning strongly agree) were used to tap how they acquired knowledge of the system: I am satisfied with the internal user guide for electronic mail; I am not satisfied with the on-line help on the system; and I have received a lot of informal training from other electronic mail users.

2. Uses of electronic mail

The amount of use. To measure amount of use, the respondents were asked how many messages were sent and received in a typical work week. Since many top managers at HNS ask their secretaries to handle electronic mail messages, it is beneficial to add one question asking the percentage (from 0 to 100%) of time other people use the system on their behalf.

The purposes of use. There are four purposes of use: routine, complex, socioemotional and bulletin board use. Each was measured by how often they used the system for certain purposes, with never, seldom, sometimes, often and very often as the response categories. For routine use, the respondents were asked how often they used electronic mail to exchange routine information with others, to schedule meetings, and to coordinate project activities. For complex use, they were asked how often they used electronic mail to share opinions, to resolve conflicts/disagreements, and to negotiate. For socioemotional use, they were asked how often they used electronic mail to get to know someone, to keep in touch with someone in another location, and to send notes that contain sociable or non-work related content. For bulletin board use, questions were asked about how often they sent information via electronic mail to a large number of people, read bulletin board style information, and kept track of company news.

3. Interactive use

Interactive use of electronic mail. Each of the six dimensions of interactive use-- immediacy of feedback, responsiveness, source diversity, communication linkages, equality of participation and ability to terminate--was measured by at least three items. Immediacy of feedback was measured by asking how soon they answered other people's electronic mail, how soon they answered an e-mail message if that message needed some

research before it could be answered, and how soon they received other people's feedback to their messages. The response categories included same day, next day, within a week, within two weeks and don't always answer messages or receive feedback.

To measure responsiveness, questions were asked about how often they started a topic of discussion in their electronic mail, how often other people responded to the subject they started, and how often they responded to other people's inputs to their earlier e-mail messages. Source diversity was measured by asking how often they received electronic mail containing the same information from different people, from people they didn't personally know, and from people they knew who were not their coworkers. Communication linkages were measured by asking how often they sent electronic mail to people they regularly communicated with face-to-face, people with whom they often communicated over the phone, people they knew who were not their coworkers, and people they didn't personally know. Ability to terminate was measured by asking how often they sent brief e-mail messages (1 or 2 lines) and long messages (3 or more paragraphs) and how often they wrote an e-mail message without sending it out. The response categories for the above items were never, seldom, sometimes, often and very often.

To measure equality of participation, the respondents were asked if they felt comfortable sending electronic mail to their supervisor and the company's top executives and using electronic mail to give their opinions to others about a topic under discussion. The response categories for these items included not at all, little, some, much and very much.

Interactive use of other media. The respondents were asked how they interacted with others in the company by using other forms of communication, e.g., face-to-face, telephone, or memos. The response categories for the six dimensions were the same as the ones used for interactive e-mail use.

Immediacy of feedback was measured by how soon they answered other people's messages, how soon they answered a message if it needed some research, and how soon they received feedback to their messages. For responsiveness, the respondents were asked how often they started a topic of discussion, how often other people responded to the subject they started, and how often they responded to other people's inputs to their earlier messages. Source diversity was measured by asking how often they received the same information from other people, how often they received memos or phone calls from people they didn't personally know and from people they knew who were not their coworkers. Communication linkages were measured by asking how often they phoned people they regularly communicated with face-to-face, how often they sent memos to people they often communicated over the phone, and how often they communicated with people they didn't personally know and people they knew who were not their coworkers. For equality of participation, the respondents were asked how comfortable they felt when they communicated with their supervisor and the company's top executives, and how comfortable they felt when giving opinions about a topic under discussion. Finally, ability to terminate was measured by asking how often they made brief phone calls (3 minutes or less), wrote short memos (1 or 2 lines), and had brief face-to-face conversations (3 minutes or less) with other people.

4. Communication in all directions

This variable assesses intraorganizational communication in four directions: *upward, downward, horizontal* and *diagonal*. The respondents were asked how often they communicated with their supervisor (upward), their subordinates (downward), people in other departments who had the same level job as they did (horizontal), the head of another department (diagonal), and top executives (diagonal). The respondents were provided with a 5-point response scale, never, seldom, sometimes, often and very often, and were instructed to leave the items blank if they were not applicable.

5. Information load

Information load. Questions were asked about the rate and complexity of information the respondents had to deal with on a daily basis. They were asked to indicate the magnitude of their agreement or disagreement on a 5-point scale for the following statements: I have to handle a great deal of information almost everyday; I usually handle complex information; I usually need other people's help with complex information before responding; and I usually spend a lot of time studying information before responding.

Information overload. Four questions were developed to evaluate the extent to which employees failed to process information as efficiently as they would like. Given the same response categories as for information load items, the respondents were asked how much they agreed or disagreed with the following statements: I receive a lot of junk mail; I usually do not respond to certain inputs; I usually can handle information as rapidly as I want to; and I don't always respond accurately when handling a great deal of information.

6. User satisfaction

Perceptions of electronic mail. There are two dimensions of perceptions: perceived utility and ease of use. Perceived utility was measured by asking respondents to rate on five 7-point semantic differentials: useful vs. useless, efficient vs. inefficient, convenient vs. inconvenient, fast vs. slow, and necessary vs. unnecessary. Perceived ease of use was measured by asking respondents to indicate how easy it was to use electronic mail for three 7-point semantic differentials: easy vs. difficult, simple vs. complex, and comfortable vs. uncomfortable.

Perceived work quality. The respondents were asked to indicate the magnitude of their agreement or disagreement on a 5-point scale for the following three statements: Using electronic mail has greatly improved the quality of my work; using electronic mail has greatly improved the quality of my department's work; and electronic mail has not made it easier to do my own work.

7. Decision quality

Items were developed to measure each of the six dimensions of decision quality: information quality, participation, consensus, speed, effectiveness and acceptance. The five response categories for all of the following statements were from "strongly disagree" to "strongly agree."

Information quality. Three statements were developed: The quality of information I'm able to get in order to make a decision is timely; the quality of information I'm able to get in order to make a decision is accurate; and the information I can get in order to make a decision is not always relevant.

Decision participation. The respondents were asked how much they agreed with the following statements: I have participated in the decision-making process as a source of information; I'm consulted by other people before a decision is made; and I give advice about how a decision should be made.

Decision consensus. They were asked how much they agreed with the following statements: I tend to agree with others about how a decision should be made; I have difficulties in agreeing with others about how a decision should be made; and I feel pressured into agreeing with others while a decision is being made.

Decision speed. For programmed decisions, three items were used: I spend a lot of time making a decision that has an established procedure to follow; I spend little time making a decision that has standard procedures to follow; and I often can make a routine decision quickly. Three items were developed for nonprogrammed decisions. They were: It takes a lot of time to make a decision that has no standard procedures to follow; it takes little time to make decisions that require innovative solutions; and I spend a lot of time making a decision that requires creative thinking.

Decision effectiveness. The respondents were asked how much they agreed with the following statements: I'm satisfied with the quality of my decision; I make effective decisions; and the quality of my department's decisions is not satisfactory.

Decision acceptance. Decision acceptance was measured by asking the respondents to indicate how much they agreed with the following statements: I usually accept the result once a decision is made; It's hard to accept decisions that have been made; and I tend to accept a decision when I've been involved in the decision-making process.

Finally, it is necessary to acquire specific information about how electronic mail has helped improve the quality of their decision. The respondents were asked to give an example. Answers to this open-ended question were not analyzed on the computer, but will be discussed in the discussion chapter.

8. Background information

Questions were asked about their gender (male or female), their age, their educational level (less than high school diploma, high school diploma, some college, undergraduate degree, master's degree, or Ph.D.), number of years they have worked for the company, their job level (non manager, first level supervisor, middle management, or upper management), and job category (marketing/account management, planning, programming, research, engineering, clerical, public relations, finance/accounting, systems operations, personnel, training, or other (specify)).

Pretest

This questionnaire was pretested first at Michigan State with five administrators and secretaries who had e-mail accounts. The idea was to find out how long it took and how easy it was to complete the questionnaire. Some items were paraphrased and some instructions were clarified, as suggested by those participants. Then, it was pretested with 11 e-mail users in the company to find out how applicable the questions were. Some participants were confused with the two sections of items regarding e-mail interaction and generation interaction among organizational members. To ensure that respondents answer both sections of questions, items pertaining to generation interaction were placed immediately after those pertaining to e-mail interaction plus instructions making it clear that the latter section asks about how they communicate with other people besides using electronic mail. A cover letter was added to the questionnaire, stating that this study was

endorsed by the company. Their participation was completely voluntary and their anonymity was guaranteed. The cover letter also briefly explains the purpose of this study and providing instructions for completing and returning the questionnaire. See Appendix 3 for the cover letter and final version of the questionnaire.

Data Collection

The questionnaire was distributed in April, 1992, by mail to 953 e-mail users identified by the company. In two weeks 172 questionnaires were returned. An e-mail message was then sent to all users to remind them of the survey (see Appendix 3), and 20 more questionnaires were returned in the next three weeks. Thus, a total of 192 questionnaires were returned, corresponding to a response rate of 20%. Among them, one was incomplete and was excluded from data analysis.

Sample Characteristics

The respondents consisted of 72% (n=137) male and 28% (n=54) female. They averaged approximately 37 years of age (mean=36.8, s.d.=8). Almost all respondents (n=184, 96%) attended college, 40% (n=74) of whom got an undergraduate degree and 36% (n=68) of whom went to get a graduate or law degree. They had worked for the company for an average of 6 years (s.d.=4.6). Sixty percent (n=115) of the respondents were non managers, whereas 11% (n=21) were first level supervisor, 22% (n=41) middle managers, and 7% (n=14) upper managers. A range of job types was represented, including engineering (37%), programming (9%), marketing/account management (8%), clerical (6%), finance (5%), systems operations (4%), planning (4%), and a mix of other personnel. The sample sizes across job types were too small to permit comparisons with any measure of confidence. However, essential differences in job responsibilities that

might influence e-mail use were potentially captured in various objective and perceived job characteristics. A profile of the respondents is in Table 3.

Preliminary Evaluation of Data

Data were keypunched and stored on diskette and processed through a Macintosh version of SPSSX. Several steps were taken to screen the data prior to analysis. As indicated by Tabachnick and Fidell (1983), the first step is to inspect out-of-range values, plausible means and dispersions, and variation for accuracy of input. Frequencies for all variables were run to check for keypunch errors. Variables with suspicious distributions were checked for accuracy of input.

The next step is to evaluate size and distribution of missing data. If only a few units of data are missing from a large data set, the problem will not be serious and almost all procedures for handling them will yield similar results (Tabachnick & Fidell, 1983). Although there are no rules regarding how much missing data can be tolerated for a given size of sample, it was decided for this sample of 192 that variables with 5% or below data missing should not present serious problems for data analysis. By using this criterion, only three variables presented potentially serious problems: one pertaining to the month they became a regular e-mail user (28 missing cases),¹ another pertaining to percentage of the time the respondents asked other people to use electronic mail for them (21 missing cases), and the other the extent to which they communicate with their subordinates (39 missing cases).

Tabachnick & Fidell further pointed out that the pattern of missing data may be more important than the amount missing. Randomly missing values seldom pose serious problems, while nonrandomly missing values are always serious because inferences are

Characteristics of Electronic Mail Users
Table 3

Attribute		Mean	S. D.	N
Gender				
	Male	72%		
	Female	28		191
Age				
	20-29	17%		
	30-39	50		
	40-49	25		
	50-59	8	36.82	8.05
				185
Educational Level				
	Less than high school	.5%		
	High school diploma	3		
	Some college	22		
	Undergraduate degree	39		
	Master's degree	32		
	J.D.	.5		
	Ph.D.	3		191
Tenure				
	1-5 years	58%		
	6-10 years	23		
	11-15 years	16		
	16+ years	3	6.11	4.63
				191
Job Level				
	Non manager	60%		
	First level supervisor	11		
	Middle management	22		
	Upper management	7		191
Job Category				
	Engineering	37%		
	Programming	9		
	Marketing			
	/account management	8		
	Clerical	6		
	Finance	5		
	Systems operations	4		
	Planning	4		
	Administrative	3		
	Publication	3		
	Senior management	3		
	Manufacturing	2		
	Consulting	2		
	Training	2		
	Public relations	1		
	Personnel	1		
	Other	10		188

limited to the sample from which data were obtained. All the troubling variables seemed to have nonrandomly missing values. It seemed that many respondents could not remember the month they became regular users, and the data may not be reliable. It would be better to drop this variable, and use only the year to compute media experience. Many respondents who did not answer the question about whether other people use electronic mail for them put a question mark on the space provided, so it was apparent that they did not understand the question. The researcher sensed that those who did not understand the question would mostly be non managers since it was more common among top managers to ask their secretaries to use electronic mail for them. A closer look at the missing values supported this theory; 14 of the 21 respondents who missed the question were non managers. It was then decided that the 14 missing values would be recoded as 0, meaning no one used electronic mail for them, and the remaining seven missing values remains missing. Regarding the variable measuring downward communication, it was most likely that the question was not applicable since 35 of the 39 respondents who missed the question were non managers and had no subordinates with whom to communicate. While this variable was measured by a 5-point scale (1=never, 2=seldom, 3=sometimes, 4=often, and 5=very often), it was felt that those 35 missing cases should be recoded as 0, one unit below the lowest possible rank of the scale. The other four cases would be recoded to the mean value. Further analysis would be done to check if this procedure was appropriate.

Handling missing data for the rest of the variables was fairly simple because none of them had more than seven cases, most had only two or three cases missing, which seemed to be randomly scattered in the data set. The variable measuring the year respondents became regular e-mail users had seven cases missing. Because they had been using electronic mail for an average of five years, it could be that some people simply forgot when they became regular users. It was decided that the missing values for that

variable would be recoded to the mean value. The rest of the variables that had several cases missing used either a 5-point or 7-point scale, so the missing values were recoded to the mean value. Missing cases for the background variables were left untreated since those variables were not critical to the analysis.

A third step is to identify and deal with outliers. Outliers are cases with such extreme values on one variable that they unduly affect the average value or the variability of scores. To detect outliers, one way is to use a standardized score plus and minus 3.0 as a cut (Tabachnick & Fidell, 1983). By using this criterion, two variables were found to have outliers: the number of e-mail messages sent and received in a typical work week. The respondents reported to send 0 to 150 messages (mean=22, s.d.=26.5), and receive 1 to 450 messages (mean=46, s.d.=59.5). To reduce the influence of outliers, outlying cases were first checked for accuracy of input and scores were assigned to those cases to retain them for analysis. It was decided that standardized scores larger than 3 would be recoded to 3. This procedure preserves the deviancy of a case without allowing it to be so deviant that it perturbs distribution (Tabachnick & Fidell, 1983). By using this procedure, the average number of messages sent in a work week was reduced to 21, with a standard deviation of 22.4, and the average number of messages received was reduced to 44, with a standard deviation of 47.3. Frequencies were run for a second time to ensure that the missing and outlying cases were properly treated.

Preliminary Data Analysis

After the missing data and outliers were treated, several variables were dropped from the analysis mainly because of lack of variability of scores. It was found that 185 (97%) respondents had their own terminals, only seven of whom said they had to share it with other people. Among the five people who did not have their own terminals, four said

the terminals they could use to access electronic mail were close to their desk, and only one person had to go to another building. Thus, level of access did not become a concern for the users. The data also showed that almost all respondents checked their electronic mailbox frequently, an indication of no variability in their willingness to make themselves available for electronic communication. Nine in 10 claimed they checked their electronic mailbox twice or more per day. Sixteen said they checked once a day, and only four said they didn't always check.

Some variables were also converted for analysis. The year they became regular e-mail users was converted to number of years using electronic mail as a measure of media experience. The results ranged from never becoming a regular user to 17 years of media experience, with a mean of 5.3 years and standard deviation of 3.4. Geographical dispersion was measured by asking whether their coworkers were on the same floor as they were, on another floor of the same building, in another building in the same city, in another city and/or in another country. Respondents were given one point for each location they checked, and they could receive as many as five points. The more points they received, the more dispersed their coworkers were. The mean score of this converted variable was 2.7, with a standard deviation of 1.3.

Data Analysis

1. Confirmatory factor analysis

Correlation matrices were run for measures of perceived task requirements, skill requirements, purposes of e-mail use, interactive e-mail use, interactive use of other media, information load, user satisfaction, and decision quality measures. They were checked for the magnitude and direction of the relationships among items for each measure. A series of confirmatory factor analyses (CFA) was conducted to assess the validity and reliability of

the underlying measures. Confirmatory factor analyses allow the researcher to specify expected dimensions and determine how well the given items fit the theoretical measurement model (Hunter & Gerbing, 1982). A downsized version (Hamilton & Hunter, 1988) of the PACKAGE program (Hunter & Cohen, 1969) was used to conduct the tests. The measures were first tested for internal consistency--whether items composing the underlying factor are related to one another in a consistent fashion (Hunter & Gerbing, 1982). If all items measure the same factor, correlations between the items should satisfy a "product rule for internal consistency." That is, the correlation between two items in the same factor should be the product of their correlations with the underlying factor. The CFA produces a Spearman test of the product rule for internal consistency. A residual form of the product rule is obtained from the difference between the obtained and expected (created from factor loadings) correlations. This residual should be zero or not significantly deviant from zero. No internal consistency tests can be done for factors that contain fewer than three items.

The measures were then tested for parallelism, or external consistency--whether items representing the same factor have similar patterns of correlations with items on other factors or other traits (Hunter & Gerbing, 1982). The formal statement of parallelism is the "product rule for external consistency." When x is an indicator of factor A and y an indicator of factor B , the correlation between x and y should equal the product of correlations between x and A , y and B , and A and B . The residual of the product rule should be zero or not significantly deviant from zero.

In addition to examining individual residuals, one can use chi-square tests to evaluate the overall fit of the items. Hunter recently included chi-square tests in the CFA procedure.² For internal consistency, a "flatness" test can be used to test the compound

hypothesis that all items measure the same construct (unidimensional) and the items are uniform in quality. Failure of rejecting the null leads to the conclusion that all items are unidimensional and uniform in quality. Moreover, a "gradient" test can be used to test the hypothesis that all items measure the same construct that allows for variation in item quality. Failure of rejecting the null leads to the conclusion that all items are unidimensional but variable in item quality. Similarly, both tests can be used to assess parallelism.

Factors were then defined as construct estimates, taking error of measurement into account. The CFA computes the reliability (lack of error of measurement) of each construct estimate using standard score coefficient alpha. Hunter and Gerbing (1982) stated that the criteria of internal and external consistency should be satisfied before the value of coefficient alpha can be interpreted. If one item fails the internal consistency and parallelism tests, it should be dropped from the factor. Then, the CFA procedures have to be repeated. Dropping the offending item usually, though not always, leads to improvements on internal consistency, parallelism and reliability.

The CFA also produces factor loadings. Items measuring the same factor should load high on that factor and load low on other factors. However, one often finds the results are not straightforward and may be difficult to interpret. One may have to deal with the following situations: 1) items measuring the same factor load low on that factor, but high on other factors; 2) items measuring the same factor load high both on that factor and on other factors; 3) items measuring the same factor load low both on that factor and on other factors. Hunter³ provided some guidelines to deal with items causing problems. First, one should check the content of the offending items. They can be "misplaced," meaning that they are misconceptualized to measure a certain factor, which, in fact,

measure another factor, or measure more than one factor, or do not measure any factors. These items should either be reconceptualized or be dropped from the analysis. Next, the offending items can be "contaminated" by sampling error.⁴ For example, an item that looks weak (a low loading) may not actually be weak because it's already contaminated. A weak item should be dropped if it is not "parallel" with other factors. A contaminated item may load high on more than one factor. In that case, that item should be dropped. After the offending items are dealt with, the CFA procedures have to be repeated. Dropping a noisy item does not necessarily result in a higher alpha, but it makes the results cleaner and easier to interpret. The following section describes the results of CFAs.

Perceived task requirements. The results of CFA are reported in Table 4. The tests for internal consistency and parallelism, as well as the factor loadings supported the clustering of items into two expected factors. Time pressure included time pressure, crises, urgent matters and the need for rapid decision, whereas task analyzability involved clearly defined outcomes, standard procedures and well-defined subject matter.

Purposes of e-mail use. The four dimensions of 12 purposes of use were examined for internal consistency and parallelism, and the initial factor loadings are reported in Table 5-1. The factor loadings suggested that some items measured more than one factor. People may use electronic mail to "share their opinions" about routine (factor loading=.41) as well as complex (.45) tasks. Also, "keeping in touch with others" was not limited to socioemotional use (.43); routine use (.42) and bulletin board use (.46) were also ways to keep in touch with others. These two items were then dropped from the analysis. Moreover, the CFA did not confirm "sending information to a large number of people" as bulletin board use (.02). For users, it may mean not only sending information, but getting a lot of responses in a timely fashion. In that sense, sending information to many people

Confirmatory Factor Analysis of Perceived Task Requirements
Table 4

Confirmed Characteristics of Tasks	F1: Time Pressure	F2: Task Analyzability
F 1:		
Time pressure	.65	.00
Crises, urgent matters	.94	.00
The need for rapid decision	.76	.01
F 2:		
Clearly defined outcomes	.12	.60
Standard procedures	- .12	.79
Well-defined subject matter	.01	.79
Percent of variance explained	31.88	26.81

Confirmatory Factor Analysis of Purposes of E-Mail Use: Initial Results
Table 5-1

Anticipated Individual Purposes	F 1: Routine Use	F 2: Complex Use	F 3: Socio- emotional Use	F 4: Bulletin Board Use
F 1:				
Exchange routine information	.45	.23	.36	.36
Coordinate project activities	.77	.42	.42	.39
Schedule meetings	.58	.26	.11	.35
F 2:				
Share opinions	.41	.45	.36	.25
Resolve conflicts/ disagreements	.30	.87	.17	.28
Negotiate	.30	.68	.26	.35
F 3:				
Keep in touch with others	.42	.25	.43	.46
Send sociable or non-work related notes	.19	.17	.58	.17
Get to know someone	.19	.22	.58	.33
F 4:				
Keep track of company news	.19	.28	.33	.73
Send information to a large number of people	.61	.15	.26	.02
Read bulletin board style information	.10	.23	.30	.76

seemed to be routine use, as suggested by the factor loading (.61). This item was subsequently switched to measure routine use. Table 5-2 presents the final factor loadings for the four purposes. Routine use included exchanging routine information, coordinating project activities, scheduling meetings and sending information to a large number of people, while complex use included resolving conflicts/disagreements and negotiating. Socioemotional use consisted of sending sociable or nonwork-related notes and getting to know someone, whereas keeping track of company news and reading bulletin board style information were bulletin board uses.

Interactive e-mail use. Three CFAs were conducted for the six dimensions of interactive e-mail use because different response categories were applied. First, immediacy of feedback seemed to involve how immediately feedback could be sent, but not how immediately it could be received (factoring loading=.35, see Table 6-1). "Immediacy of receiving feedback" was dropped from the final test of CFA, and the resulting factor is presented in Table 6-2. Immediacy of feedback involved how quickly people answered e-mail messages and messages that need some research. Next, the initial results suggested that equality of participation might not involve how comfortable people felt when sending electronic mail to the company's top executives (.21, see Table 7-1). It could be that some people's job did not involve communicating with top executives, but it was suspected that the respondents might have troubles with questions with reversed wording. After the unrelated item was eliminated, the resulting factor is reported in Table 7-2. Equality of participation concerns how comfortable people felt when sending electronic mail to their supervisor and to express their opinions about a topic under discussion.

The CFA test was conducted for the 13 items of interactive e-mail use (see Table 8-1). "I receive the same information from different people" appeared to be very noisy. It

Confirmatory Factor Analysis of Purposes of E-Mail Use: Final Results
Table 5-2

Confirmed Individual Purposes	F 1: Routine Use	F 2: Complex Use	F 3: Socio- emotional Use	F 4: Bulletin Board Use
F 1:				
Exchange routine information	.42	.19	.22	.20
Coordinate project activities	.69	.29	.32	.14
Schedule meetings	.70	.22	.04	.01
Send information to a large number of people	.62	.17	.14	.02
F 2:				
Resolve conflicts/ disagreements	.29	.78	.17	.18
Negotiate	.27	.78	.24	.28
F 3:				
Send sociable or non-work related notes	.14	.12	.59	.17
Get to know someone	.21	.19	.59	.22
F 4:				
Keep track of company news	.15	.23	.26	.75
Read bulletin board style information	.08	.21	.23	.75
Percent of variance explained	17.77	15.62	10.75	13.72

**Confirmatory Factor Analysis of Immediacy of Feedback for
Interactive Use of Electronic Mail: Initial Results
Table 6-1**

Anticipated Items	F 1: Immediacy of Feedback
Immediacy of answering other people's e-mail	.63
Immediacy of answering other people's e-mail that needs some research	.55
Immediacy of receiving feedback	.35

**Confirmatory Factor Analysis of Immediacy of Feedback for
Interactive Use of Electronic Mail: Final Results
Table 6-2**

Confirmed Items	F 1: Immediacy of Feedback
Immediacy of answering other people's e-mail	.59
Immediacy of answering other people's e-mail that needs some research	.59
Percent of variance explained	34.81

**Confirmatory Factor Analysis of Equality of Participation for
Interactive Use of Electronic Mail: Initial Results
Table 7-1**

Anticipated Items	F 1: Equality of Participation
Feeling comfortable sending e-mail to my supervisor	.76
Feeling pressured sending e-mail to the company's top executives*	.21
Feeling comfortable using e-mail to give opinions about a topic under discussion	.65

*: Item had been reversed before analysis was conducted.

**Confirmatory Factor Analysis of Equality of Participation for
Interactive Use of Electronic Mail: Final Results
Table 7-2**

Confirmed Items	F 1: Equality of Participation
Feeling comfortable sending e-mail to my supervisor	.70
Feeling comfortable using e-mail to give opinions about a topic under discussion	.70
Percent of variance explained	49.00

**Confirmatory Factor Analysis of Interactive Use
of Electronic Mail: Initial Results
Table 8-1**

Anticipated Factor Items	F 1: Respon- siveness	F 2: Source Diversity	F 3: Comm. Linkages	F 4: Ability to Terminate
F 1:				
I start topics of discussion in my e-mail	.82	.46	.46	.78
People respond to the subjects I start	.89	.60	.37	.68
I respond to other people's inputs to my earlier e-mail message	.61	.60	.32	.52
F 2:				
I receive same info from different people	.34	.24	.17	.41
I receive e-mail from people I don't know	.27	.72	.40	.64
I receive e-mail from non-coworkers	.22	.22	.53	.32
F 3:				
I send e-mail to people I regularly talk with face-to-face	.28	.27	.54	.64
I send e-mail to people with whom I often speak on the phone	.37	.41	.79	.75
I send e-mail to non-coworkers	.18	.64	.35	.41
I send e-mail to people I don't know	.24	.71	.48	.77
F 4:				
I send short e-mail messages	.32	.58	.61	.44
I write an e-mail message, but don't send it	.10	.35	.02	.17
I send long e-mail messages	.32	.09	.41	.20

seemed to involve the content of information, instead of the source of information. It was then dropped from the analysis. Moreover, the initial results suggested that the other six items measuring source diversity and communication linkages were intercorrelated. It did not matter whether the user was the source or the receiver of a piece of information. What mattered was that the user was connected to others in the network. Thus, the six items were combined to measure only one construct. Finally, the three items measuring abilities to terminate appeared to be very noisy, all of which did not capture the essence of abilities to terminate. Since the error was so large, all three items were dropped from the analysis. A second test of CFA was conducted for the remaining nine items, and the results (see Table 8-2) were much cleaner and easier to interpret. Responsiveness included: I start topics of discussion in my electronic mail; people respond to the subjects I start; and I respond to other people's inputs to my earlier e-mail message. Communication diversity included: I receive e-mail messages from people I don't know and from noncoworkers; I send e-mail messages to people I regularly communicate face-to-face and over the phone; and I send e-mail messages to noncoworkers and people I don't know.

Load of information. Eight items regarding the load of information people have to deal with were examined by the CFA (see Table 9-1). Both factors failed tests of internal consistency and parallelism. A closer examination of the items revealed weaknesses of conceptualization. When people "need help with information" or "study information for a long time", they are already experiencing information overload. A second CFA test was done to include the two items as measures of information overload, leaving the factor--information load--with only two items (see Table 9-2). The second factor, information overload, became unidimensional and parallel to the first factor,⁵ but two of the items suggested potential problems. It appeared that information overload dealt with difficulties of information processing. People experience overload when they fail to process

**Confirmatory Factor Analysis of Interactive Use
of Electronic Mail: Final Results
Table 8-2**

Confirmed Items	F 1: Responsiveness	F 2: Communication Diversity
F 1:		
I start topics of discussion in my e-mail	.82	.44
People respond to the subjects I start	.91	.40
I respond to other people's inputs to my earlier e-mail message	.60	.35
F 2:		
I receive e-mail from people I don't know	.27	.40
I receive e-mail from non-coworkers	.22	.53
I send e-mail to people I regularly talk with face-to-face	.28	.39
I send e-mail to people with whom I often speak on the phone	.37	.59
I send e-mail to non-coworkers	.18	.56
I send e-mail to people I don't know	.24	.61
Percent of variance explained	25.41	23.37

Confirmatory Factor Analysis of Load of Information: Initial Results
Table 9-1

Anticipated Items	F 1: Information Load	F 2: Information Overload
F 1:		
I handle a great deal of information everyday	.49	- .18
I usually handle complex information	.63	.01
I need help with complex information	.11	.46
I spend a lot of time studying information	.22	.48
F 2:		
I receive a lot of junk mail	.23	.40
I do not respond to certain inputs	.09	.32
I don't always respond accurately	.28	.46
I can handle information as rapidly as I want to*	.27	.40

*: Item had been reversed before analysis was conducted.

Confirmatory Factor Analysis of Load of Information: Secondary Results
Table 9-2

Items	F 1: Information Load	F 2: Information Overload
F 1:		
I handle a great deal of information everyday	.77	-.16
I usually handle complex information	.77	-.02
F 2:		
I need help with complex information	-.10	.50
I spend a lot of time studying information	-.03	.52
I receive a lot of junk mail	.10	.28
I do not respond to certain inputs	-.05	.26
I don't always respond accurately	-.14	.56
I can handle information as rapidly as I want to*	-.08	.47

*: Item had been reversed before analysis was conducted.

information as efficiently or effectively as they would like. In other words, they will still try to cope with the situation. When they simply "ignore certain inputs," they do not have to show any efforts to deal with the information. Also, "receiving too much junk mail" does not provide any clue as to how people will handle that kind of information. With the two items--I receive a lot of junk mail and I do not respond to certain inputs--removed, the CFA test was repeated. The final results are reported in Table 9-3. Information load consisted of the amount and complexity of information. Information overload included four items: I need help with complex information; I spend a lot of time studying information; I don't always respond accurately; and I can handle information as rapidly as I want to.

User satisfaction. Eight items of perceptions of electronic mail were examined for internal consistency and parallelism, and the two anticipated factors were supported, as presented in Table 10. Perceived utility involved whether electronic mail was useful, fast, necessary, efficient and convenient, whereas perceived ease of use dealt with whether electronic mail was easy, simple and comfortable. In addition, the CFA test supported the three items measuring perceived work quality (see Table 11). They were: Using electronic mail has greatly improved the quality of my work and my department's work, and electronic mail has not made it easier to do my own work.

Decision quality. Twenty-one items were used to measure seven dimensions of decision quality. An examination of the correlation matrix revealed a major problem with one item, "I tend to agree with others." This item and another two items (I feel pressured into agreeing with others and I have difficulties in agreeing with others) were expected to measure one factor: decision consensus, but it was negatively related to those other two items. The other two items had been reversed before the correlation matrix was produced.

Confirmatory Factor Analysis of Load of Information: Final Results
Table 9-3

Confirmed Items	F 1: Information Load	F 2: Information Overload
F 1:		
I handle a great deal of information everyday	.77	- .14
I usually handle complex information	.77	- .11
F 2:		
I need help with complex information	- .10	.53
I spend a lot of time studying information	- .03	.51
I don't always respond accurately	- .14	.62
I can handle information as rapidly as I want to*	- .08	.53
Percent of variance explained	20.38	20.63

*: Item had been reversed before analysis was conducted.

**Confirmatory Factor Analysis of Perceptions of Electronic Mail
Table 10**

Individual Characteristics	F 1: Perceived Utility	F 2: Perceived Ease of Use
F 1:		
Useful	.88	.58
Fast	.54	.39
Necessary	.73	.53
Efficient	.69	.55
Convenient	.79	.60
F 2:		
Easy	.66	.86
Simple	.43	.77
Comfortable	.69	.81
Percent of variance explained	47.45	42.76

**Confirmatory Factor Analysis of Perceived Work Quality
Table 11**

Items	F 1: Work Quality
Using e-mail has greatly improved the quality of my work	.94
Using e-mail has greatly improved the quality of my department's work	.92
E-mail has not made it easier to do my own work*	.53
Percent of variance explained	69.54

***: Item had been reversed before analysis was conducted.**

The offending item was also spot checked for possible incorrect data entry. When all measures were taken and the problem could not be corrected, the offending item was dropped from the CFA tests.

The remaining 20 items were examined by the CFA and the initial results generally suggested that the respondents had troubles with questions with reversed wording (see Table 12-1). All items with reversed wording were dropped from further analysis for various reasons. "The information I can get in order to make a decision is not always relevant" was dropped because of a low factor loading (.34). The remaining two items measuring decision consensus were dropped because they did not appear to measure the construct well (.41, respectively, and similar loadings across the board). "My department's decision are not satisfactory" loaded very low (.24) on decision effectiveness but higher on other factors. It was then eliminated. Another noisy item (it's hard to accept decisions) that was expected to measure decision acceptance loaded very high (.75) on decision consensus. There is a major difference between the two constructs; consensus is achieved during the decision-making process, while acceptance deals with people's willingness to accept the final decision. But the initial results indicated that the respondents failed to distinguish the two. Therefore, that item was also dropped. Furthermore, routine decisions can be nonprogrammed. The results showed that nonprogrammed decisions should include routine decisions (.50 on nonprogrammed decisions and .39 on programmed decisions), so programmed decisions were left with two items.

The CFA procedure was repeated for the remaining 15 items and the results were much easier to interpret. Information quality included timely and accurate information, whereas decision participation included three items: I participate in the decision-making process as a source of information; I'm consulted by others before a decision is made; and I

Confirmatory Factor Analysis of Quality of Decision-Making: Initial Results
Table 12-1

Anticipated Items	F 1: Information Quality	F 2: Decision Participation	F 3: Decision Consensus	F 4: Speed for Programmed Decisions		F 5: Speed for Non- programmed Decisions		F 6: Decision Effectiveness	F 7: Decision Acceptance
				Decisions	Decisions	Decisions	Decisions		
F1: Information is timely	.55	.31	.41	-.27	-.21	-.21	.43	.10	
Information is accurate	.86	.28	.12	.10	.10	.10	.41	.12	
Information is not relevant*	.34	.02	.27	.09	-.14	-.14	.11	.06	
F2: I am a source of information	.23	.62	.25	-.23	-.25	-.25	.41	.22	
I'm consulted by others	.34	.70	.24	-.19	-.08	-.08	.43	.14	
I give advice	.09	.60	-.02	-.36	-.18	-.18	.24	.20	
F3: I feel pressured into agreeing with others*	.02	.06	.41	-.23	-.26	-.26	.36	.15	
I have difficulties in agreeing with others*	.36	.14	.41	-.31	-.19	-.19	.38	.53	
F4: Routine decisions	-.22	-.40	-.36	.39	.50	.50	-.53	-.15	
Decisions having established procedures to follow	-.02	-.11	-.36	.65	.15	.15	-.28	-.35	
Decisions having standard procedures to follow	-.04	-.20	-.44	.72	.08	.08	-.33	-.37	
F5: Decisions having no standard procedures to follow	-.34	-.26	-.40	.27	.52	.52	-.33	-.07	
Decisions requiring creative thinking	.02	.06	-.24	.11	.48	.48	-.14	-.01	
Decisions requiring innovative solutions	-.07	-.22	-.19	.26	.54	.54	-.30	-.04	
F6: I'm satisfied with the quality of my decisions	.32	.26	.63	-.33	-.33	-.33	.64	.22	
I make effective decisions	.11	.38	.48	-.47	-.34	-.34	.81	.48	
My department's decisions are not satisfactory*	.48	.31	.41	-.29	-.18	-.18	.24	.44	
F7: It's hard to accept decisions*	.21	.09	.75	-.32	-.10	-.10	.33	.33	
I accept the result once a decision is made	.06	.10	.25	-.15	.10	.10	.32	.54	
I tend to accept a decision when I've been involved in the decision-making process	-.04	.22	.13	-.22	-.11	-.11	.28	.51	

*: Item had been reversed before analysis was conducted.

give advice about how a decision should be made. Speed for programmed decisions concerned speed for making decisions that have established and standard procedures to follow, while speed for nonprogrammed decisions dealt with speed for making decisions that have no standard procedures to follow, require creative thinking and innovative solutions, and are routine. Decision effectiveness involved how satisfied people are with the quality of their decisions, and how effective they perceived their decisions to be. Finally, decision acceptance included two items: I accept the result once a decision is made and I tend to accept a decision when I've been involved in the decision-making process. The final results are presented in Table 12-2.

Interactive use of other media. The three items measuring immediacy of feedback were supported by the CFA (see Table 13). They were: immediacy of answering other people's messages, answering messages that need some research, and receiving feedback to their messages. The three items measuring equality of participation were examined, and the results showed that the respondents, again, had problems with items with reversed wording. "Feeling pressured when communicating with my supervisor" (factor loading=.37, see Table 14-1) was dropped, leaving two items for the factor: feeling comfortable communicating with the company's top executives and giving opinions about a topic under discussion. The final results are reported in Table 14-2.

The CFA procedure was conducted for the 13 items regarding the other four dimensions. As shown in Table 15-1, several items appeared to measure more than one construct. "I respond to other people's inputs to my messages" and "I write short memos" loaded relatively high (.42 to .59) on more than one dimension; both were dropped from further analysis. "I receive the same information from different people" dealt with the content of information rather than the source of information (.14 on source diversity), and

Confirmatory Factor Analysis of Quality of Decision-Making: Final Results
Table 12-2

Confirmed Items	F 1: Information Quality	F 2: Decision Participation	F 3:		F 4:		F 5: Decision Effectiveness	F 6: Decision Acceptance
			Speed for Programmed Decisions	Speed for Nonprogrammed Decisions	Speed for Programmed Decisions	Speed for Nonprogrammed Decisions		
F 1: Information is timely Information is accurate	.69 .69	.31 .28	-.18 .00	-.27 -.16	.23 .30	.00 .08		
F 2: I am a source of information I'm consulted by others I give advice	.30 .38 .14	.62 .70 .60	-.11 -.08 -.25	-.31 -.17 -.28	.27 .37 .21	.11 .18 .28		
F 3: Decisions having established procedures to follow Decisions having standard procedures to follow	-.04 -.14	-.11 -.20	.69 .69	.23 .20	-.20 -.26	-.19 -.30		
F 4: Decisions having no standard procedures to follow Decisions requiring creative thinking Decisions requiring innovative solutions Routine decisions	-.32 .03 -.06 -.28	-.26 .06 -.22 -.40	.13 .04 .09 .39	.56 .40 .59 .50	-.28 -.17 -.28 -.51	.01 -.06 .04 -.13		
F 5: I'm satisfied with the quality of my decisions I make effective decisions	.38 .18	.26 .38	-.16 -.33	-.43 -.44	.72 .72	.22 .50		
F 6: I accept the result once a decision is made I tend to accept a decision when I've been involved in the decision-making process	.04 .01	.10 .22	-.21 -.17	.09 -.16	.28 .25	.53 .53		
Percent of variance explained	9.94	12.57	9.12	11.67	13.30	7.11		

**Confirmatory Factor Analysis of Immediacy of Feedback for Interactive Use
of Media Other Than Electronic Mail
Table 13**

Confirmed Items	F 1: Immediacy of Feedback
Immediacy of answering other people's messages	.78
Immediacy of answering other people's messages that need some research	.64
Immediacy of receiving feedback	.52
Percent of variance explained	45.93

**Confirmatory Factor Analysis of Equality of Participation for Interactive Use
of Media Other Than Electronic Mail: Initial Results
Table 14-1**

Anticipated Items	F 1: Equality of Participation
Feeling comfortable communicating with the company's top executives	.80
Feeling pressured when communicating with my supervisor*	.37
Feeling comfortable giving opinions about a topic under discussion	.55

*: Item had been reversed before analysis was conducted.

**Confirmatory Factor Analysis of Equality of Participation for Interactive Use
of Media Other Than Electronic Mail: Final Results
Table 14-2**

Confirmed Items	F 1: Equality of Participation
Feeling comfortable communicating with the company's top executives	.66
Feeling comfortable giving opinions about a topic under discussion	.66
Percent of variance explained	43.56

**Confirmatory Factor Analysis of Interactive Use of Media
Other Than Electronic Mail: Initial Results
Table 15-1**

Anticipated Items	F 1: Respon- siveness	F 2: Source Diversity	F 3: Communi- cation Linkages	F 4: Ability to Terminate
F 1:				
I start a topic of discussion	.79	.49	.25	.23
Other people respond to the subject I start	.92	.40	.16	.13
I respond to other people's inputs to my messages	.59	.52	.18	.24
F 2:				
I receive same info from different people	.48	.14	.13	.13
I receive memos or phone calls from people I don't know	.28	.68	.58	.34
I receive phone calls or memos from non-coworkers	.22	.77	.67	.29
F 3:				
I phone people I regularly communicate with face- to-face	.07	.28	.44	.31
I send memos to people with whom I often communicate on the phone	.24	.49	.52	.47
I communicate with non-coworkers	.12	.59	.70	.31
I communicate with people I don't know	.20	.76	.76	.34
F 4:				
I make brief phone calls	.11	.25	.38	.72
I write short memos	.23	.44	.42	.46
I make brief face-to-face conversations	.14	.18	.27	.64

was dropped. The remaining two items measuring source diversity and the four items measuring communication linkages were treated as measures of one dimension because they shared communalities, meaning the six items were probably measuring the same construct.

The CFA was repeated for the three dimensions, and the results are shown in Table 15-2. One item (I phone people I regularly communicate with face-to-face) showed a weak relationship with the newly defined dimension--communication diversity. A third CFA was performed after that item was dropped. The final results are presented in Table 15-3. Responsiveness included: I start a topic of discussion and other people respond to the subject I start. Communication diversity included five items: I receive memos or phone calls from people I don't know and from noncoworkers; I send memos to people with whom I often communicate on the phone; and I communicate with noncoworkers and people I don't know. Finally, ability to terminate was measured by two items: I make brief phone calls and brief face-to-face conversations.

The scales of all resulting factors were created by averaging across the clustered items. Summary statistics of the scales will be reported in the next chapter.

2. Bivariate correlation

To test the hypotheses, Pearson Correlation tests were conducted by using SPSSX. The correlation coefficient for each pair of variables was tested for statistical significance. A minimum significance level was set at .05. Because "access to electronic mail" had been dropped from the analysis, the five hypotheses (H1.1.1-H1.1.5) related to that variable were also removed. Interactive e-mail use was conceptualized to consist of six dimensions, but the data supported only four dimensions: immediacy of feedback, responsiveness,

**Confirmatory Factor Analysis of Interactive Use of Media
Other Than Electronic Mail: Secondary Results
Table 15-2**

Items	F 1: Responsiveness	F 2: Communication Diversity	F 3: Ability to Terminate
F 1:			
I start a topic of discussion	.85	.28	.20
Other people respond to the subject I start	.85	.18	.07
F 2:			
I receive memos or phone calls from people I don't know	.24	.67	.30
I receive phone calls or memos from non-coworkers	.19	.72	.18
I phone people I regularly communicate with face- to-face	.11	.38	.32
I send memos to people with whom I often communicate on the phone	.20	.51	.25
I communicate with non-coworkers	.11	.70	.29
I communicate with people I don't know	.17	.80	.29
F 3:			
I make brief phone calls	.10	.36	.68
I make brief face-to-face conversations	.12	.24	.68

**Confirmatory Factor Analysis of Interactive Use of Media
Other Than Electronic Mail: Final Results
Table 15-3**

Confirmed Items	F 1: Responsiveness	F 2: Communication Diversity	F 3: Ability to Terminate
F 1:			
I start a topic of discussion	.85	.28	.20
Other people respond to the subject I start	.85	.18	.07
F 2:			
I receive memos or phone calls from people I don't know	.24	.67	.30
I receive phone calls or memos from non-coworkers	.19	.72	.18
I send memos to people with whom I often communicate on the phone	.20	.45	.25
I communicate with non-coworkers	.11	.67	.29
I communicate with people I don't know	.17	.84	.29
F 3:			
I make brief phone calls	.10	.33	.68
I make brief face-to-face conversations	.12	.20	.68
Percent of variance explained	18.27	28.71	14.70

communication diversity and equality of participation. All hypotheses regarding interactive e-mail use were tested on each dimension for significance. Moreover, each of the four distinctive directions of communication was not stated in hypothesis form but was tested for significance. Since all hypotheses were derived from the theoretical model, multiple regressions were conducted to check for spuriousness. In other words, partial correlations may be more reliable because zero-order correlations may be largely reduced by holding other independent variables in the same equation constant.

To examine patterns of interactive general use, the same six dimensions were used, but, as suggested by the data, only five dimensions emerged: immediacy of feedback, responsiveness, communication diversity, equality of participation and ability to terminate. Since the first four dimensions were comparable to those of e-mail use, Pearson Correlation tests were conducted to assess their relationships. Although no hypotheses were proposed for these relationships, significance levels will be reported.

3. Path analysis

As stated in Chapter 3, the conceptual model depicted in Figure 1 is constructed in a broader context to include a variety of CMC systems, while the model tested is limited to electronic mail. This model is a causal one, in that objective (geographic dispersion) and subjective (time pressure and task analyzability) task requirements and personal characteristics (accessibility of individuals to others, media experience and skill requirements) have direct effects on e-mail usage, but indirect effects on interactive e-mail use, communication in all directions, and communication outcomes (information load, user satisfaction and decision quality). Furthermore, e-mail usage has a direct effect on interactive e-mail use and communication in all directions, but indirect effects on communication outcomes. Interactive e-mail use has an indirect effect on information load

and direct effects on user satisfaction and decision quality. Lastly, communication in all directions has a direct effect on information load. This model is also an overidentified one because certain links are deleted. That is, certain variables are implicitly hypothesized to have no direct effects on others. In this model, objective and subjective task requirements and personal characteristics are exogenous variables, whose variability is assumed to be determined by causes outside the model, whereas the remaining variables are endogenous, whose variance is explained by the exogenous and/or endogenous variables in the model. This model is also recursive, meaning at a given point in time a variable cannot be a cause and an effect of another variable.

Path analysis is used to study the direct and indirect causal relationships shown in the model. As Pedhazur (1982) noted, path analysis is not a method for deducing causal relations from correlation coefficients, but "a method applied to a causal model formulated by the researcher on the basis of knowledge and theoretical considerations" (p. 580). Path analysis starts with a set of structural equations representing the structure of hypothesized relationships among variables in the model. Since the technique of obtaining estimates of path coefficient rests in the basic regression model, assumptions for regression analysis should be satisfied (Asher, 1983). Many assumptions are not crucial in describing a data set. But if inferences are to be made about the population where the data were drawn, satisfaction of those assumptions will substantially increase the number of useful inferences (Cohen & Cohen, 1983; Tabachnick & Fidell, 1983). The following is a brief discussion of whether the variables in the model meet those assumptions.

Level of measurement. The first assumption is the requirement of interval-level data, which is necessary for computing correlation coefficients. In this study, most

variables were measured at ordinal level. However, violating this assumption such as treating ordinal-level data as interval should not present serious problems (Asher, 1983).⁶

Normality. Variables in the equation are assumed to be normally distributed in the population. The value for skewness can be used to check for normality. It equals zero if the distribution is normal. A skewed distribution is one that has a skewness value beyond the range of plus and minus 2.58 standard error for skewness (Tabachnick & Fidell, 1983).

Linearity. The assumption of linearity is that the relationship between two variables, between one variable and a combination of other variables, or between two sets of variables can be described by a straight line. Bivariate scattergrams can be used to detect gross departures from linearity. If the scattergram is roughly oval-shaped, the relationship is predominantly linear (Tabachnick & Fidell, 1983).

Homoscedasticity. The assumption of homoscedasticity is that the variability of one variable is roughly the same as that of the other variable. Scatterplots can be checked for homoscedasticity or heteroscedasticity (Tabachnick & Fidell, 1983).

Violations of the above three assumptions can be corrected by transforming the data. Although transformed variables will not increase difficulties in interpretation, they do not always perform better than the original ones (Tabachnick & Fidell, 1983). Fortunately, regression analysis is robust to many violations of those three assumptions (Cohen & Cohen, 1983; Pedhazur, 1982; Tabachnick & Fidell, 1983). It was decided that variables in the model would be checked for serious departures from the above three assumptions. When data transformation was considered necessary, analysis would be repeated for the

transformed and original variable. If the transformed variable performed no better than the original, the original variable would be kept in the analysis.

The error term. In addition to homoscedasticity, there are several other assumptions about the error term: 1) the errors are normally distributed about a mean of zero; 2) pairs of error terms are not related; and 3) the independent variable and error term in the same equation are not related (Asher, 1983; Pedhazur, 1982).

Measurement error. It is assumed that the independent variable is measured without error.

For multiple regression, multicollinearity may result in difficulties in estimating regression statistics. Multicollinearity occurs when two independent variables are perfectly, or nearly perfectly, correlated with each other, or when one independent variable is perfectly correlated with the combination of other independent variables. Multicollinearity can be detected by first producing a correlation matrix for all independent variables. Correlation coefficients that are above .9 reveal redundant variables. Multiple regression is then conducted with each variable in turn serving as dependent variable and all others as independent variables. A high squared multiple correlation indicates multicollinearity among independent variables (Tabachnick & Fidell, 1983). The same procedure can be done to check for singularity. Singularity occurs when a subscale of an independent variable can be derived on the basis of another subscale or a linear combination of several subscales. If independent variables do not appear to be multicollinear, they are seldom singular. If either exists, the best way is to drop the offending variable. Because one variable is a combination of others, information is not lost by dropping it. Exogenous variables in the model were checked for multicollinearity and singularity.

In addition to the above assumptions, there are more assumptions about the application of path analysis. Each endogenous variable is assumed to be a linear combination of exogenous and/or endogenous variables in the model. Exogenous variables are assumed to be determined by causes outside the model. Also, when exogenous variables are correlated with one another, these correlations remain unanalyzed.

After the assumptions were checked, a path analysis was conducted. A least squares path analysis contained in the PACKAGE program (Hunter, Gerbing, Cohen, & Nicol, 1980; Hunter & Hamilton, 1986) was used to determine the overall fit of the conceptual model to the data. The path program first estimates path coefficients (Beta weights) by using multiple regression. The observed zero-order correlations between all variables specified in the model are then reproduced to assess the fit of the model. The criteria used to reproduce the correlations are as follow:

- 1) the correlations between the exogenous variables are simply entered as is;
- 2) the first endogenous variable is entered using the path coefficients of that endogenous variable and correlations between the exogenous variables;
- 3) the second endogenous variable is entered using the path coefficients of the endogenous variable, correlations between exogenous variables, and correlations between exogenous variables and the first endogenous variable.

The third criterion is sequentially applied to each successive variable in the model (Hunter & Gerbing, 1982). The discrepancies between observed and reproduced correlations serve as a measure of fit. Finally, a more precise cell-by-cell sampling error analysis is done to generate an overall chi-square test of goodness of fit, with degrees of freedom equal to the number of missing links. A significant chi square at .05 level leads to the rejection of the null hypothesis, indicating that the model does not fit the data. Thus, the larger probability associated with the chi square, the better the fit of the model. This

chi-square test is suitable for testing overidentified models (Pedhazur, 1982), which is the case for the model to be tested.

To reduce the complexity of this model, separate path analyses were conducted for the 10 variables regarding communication outcomes. Because the path program does not report the significance of Beta weights, separate regressions were run by using SPSSX. For each path model, 14 regressions were run. The results of regressions, including part correlation coefficients, multiple R, R square, adjusted R square and analysis of variance, were reported.

Overview

Hypothesis testing assesses the magnitude and direction of linear relationships of variables at issue. The path coefficients help us examine direct and indirect effects of variables on others. Finally, testing the model gives us an overview of how use of electronic mail might influence people's work and decision quality.

Endnotes

- ¹ The month and year a person became regular e-mail user were coded as two separate variables. There were only seven missing cases for the year.
- ² Hunter updated the CFA in June, 1992 by adding chi-square tests for both internal consistency and parallelism.
- ³ A personal conversation with Hunter on July 10, 1992.
- ⁴ The CFA is sensitive to sample size and the number of items measuring the same factor. Although it is difficult to calculate sampling error, there is always a possibility that sampling error is in effect.
- ⁵ The internal consistency test could not be done for the first factor because it had only two items.
- ⁶ See Asher (1983), pp. 27 & 90 for arguments for treating ordinal-level data as interval.

CHAPTER 5: RESULTS

This chapter presents summary statistics of all variables, indices and scales and statistical results of hypothesis testing. All variables, indices and scales in the conceptual model are presented together. The exogenous variables are described, followed by endogenous variables. Variables that are not in the model are presented separately. In addition, the results of path analysis are reported, including path coefficients, significance tests of the path coefficients and the overall fit of the models.

Describing Variables, Indices and Scales

1. Variables in the model

Table 16 shows the means and standard deviations of all variables in the model. Reliability coefficients (alphas) are available only for scales resulting from confirmatory factor analyses.

Exogenous variables. Coworkers were geographically dispersed. Eighty-two percent of the respondents reported to have coworkers on the same floor as they did. Seventy-five percent had coworkers on another floor of the same building, 53% had coworkers in another building, 42% in another city, and 17% in another country. As described in Chapter 4, the five variables were combined to form an index called geographical dispersion (mean=2.7, s.d.=1.29).

Two anticipated factors emerged as subjective task requirements. The tasks of the respondents involved much time pressure (mean=3.99, s.d.=.76), but not as much

Summary Statistics for Variables and Scales in the Model
Table 16

	Mean	S. D.	Alpha
EXOGENOUS VARIABLES:			
<u>Objective task requirements:</u>			
- geographic dispersion	2.71 ^a	1.29	n/a
<u>Subjective task requirements:</u>			
- time pressure	3.99 ^b	.76	.82
- task analyzability	3.23 ^b	.83	.76
<u>Personal characteristics:</u>			
(Accessibility of individuals)			
- need to communicate	4.22 ^b	.89	n/a
- information for communication	3.58 ^b	.89	n/a
(Media experience)			
- experience with electronic mail	5.35(years)	3.40	n/a
(Skill requirements)			
- typing skills	3.45 ^c	1.20	n/a
- knowledge of e-mail system	3.06 ^b	.76	n/a
- training	3.04 ^b	1.12	n/a

N=191

a: Score ranged from 1 to 5. A larger score means coworkers more geographically dispersed.

b: Variable or scale ranged from 1=not at all to 5=very much.

c: Variable ranged from 1=very slow to 5=rapid, accurate typing.

Table 16 (Cont'd)

	Mean	S. D.	Alpha
ENDOGENOUS VARIABLES:			
<u>E-mail usage:</u>			
- number of messages sent	21.08(wk)	22.40	n/a
- routine use	3.82 ^d	.75	.69
- complex use	2.42 ^d	.92	.70
- socioemotional use	2.12 ^d	.74	.52
- bulletin board use	3.11 ^d	1.08	.72
<u>Interactive e-mail use:</u>			
- immediacy of feedback	4.31 ^e	.60	.52
- responsiveness	3.25 ^d	.83	.82
- communication diversity	3.19 ^d	.59	.68
- equality of participation	3.98 ^b	.85	.66
<u>Communication in all directions:</u>			
- upward	4.04 ^d	.86	n/a
- downward	3.43 ^d	1.81	n/a
- horizontal	3.74 ^d	.93	n/a
- diagonal	2.83 ^d	.99	n/a
<u>Load of information:</u>			
- information load	3.97 ^b	.73	.74
- information overload	2.72 ^b	.60	.63
<u>User satisfaction:</u>			
- perceived utility	6.01 ^f	1.00	.85
- perceived ease of use	5.52 ^f	1.29	.85
- work quality	3.58 ^b	.83	.83
<u>Decision quality:</u>			
- information quality	3.45 ^b	.64	.64
- decision participation	3.59 ^b	.64	.67
- speed for programmed decisions	2.25 ^g	.63	.64
- speed for nonprogrammed decisions	2.61 ^g	.53	.58
- decision effectiveness	3.96 ^b	.47	.68
- decision acceptance	3.89 ^b	.49	.44

b: Variable or scale ranged from 1=not at all to 5=very much.

d: Scale ranged from 1=never to 5=very often.

e: Scale ranged from 1=don't always answer e-mail/receive feedback to 5=answer/receive the same day.

f: Scale ranged from 1=not at all to 7=very much.

g: Scale ranged from 1=very little to 5=very much.

analyzability (mean=3.23, s.d.=.83). The two factors were not related to each other ($r=.00$).

Accessibility of individuals to others, media experience and skill requirements are considered as personal characteristics. Accessibility of individuals included: number of times checking electronic mailboxes, a perceived need to use electronic mail to communicate with others, and a perception of having enough information for communication by electronic mail. Because 90% of the respondents said they checked their electronic mailboxes twice or more per work day, this variable was dropped from the analysis. The respondents felt that there was a need to communicate (mean=4.22, s.d.=.89) and that they had a fair amount of information for communication (mean=3.58, s.d.=.89). The respondents had fairly long experience, an average of 5.35 years, using electronic mail. Four items were used to measure skill requirements: typing skills, knowledge of the user guide, knowledge of the online help, and informal training. The typing skills of the respondents were characterized by between "slow" and "moderate" touch typing (mean=3.45, s.d.=1.2), and they did not receive much informal training from other e-mail users (mean=3.04, s.d.=1.12). Neither item was related to the other two variables (r 's=-.07 to .03), so both were kept as separate measures of skill requirements. The two knowledge items were strongly correlated ($r=.48$) and were combined as one measure, with an average of 3.06 (s.d.=.76) on a 5-point scale, an indication of having not much knowledge of the particular system. Some respondents noted that they did not know a user guide existed.

Endogenous Variables. The respondents reported to send an average of 21 messages per work week (s.d.=22.4), a fairly large amount of use when compared with other studies in organizational settings. During the pre-survey interviews, several

enthusiastic users said they spent 1 to 1.5 hours per day answering e-mail messages, which is probably a close description of the average user. Routine use appeared to be the most common purpose of using electronic mail (mean=3.82, s.d.=.75), followed by bulletin board use (mean=3.11, s.d.=1.07). Electronic mail was not often used to perform complex tasks (mean=2.42, s.d.=.82), or send socioemotional content (mean=2.12, s.d.=.69).

The respondents reported that they answered other people's e-mail messages quickly (mean=4.31, s.d.=.6) and communicated with a variety of people (mean=3.19, s.d.=.59), including coworkers, noncoworkers, people they personally knew, and people they didn't know. They felt they could participate in the communication process equally by using electronic mail (mean=3.98, s.d.=.85). The degree of responsiveness fell between "sometimes" and "often" (mean=3.25, s.d.=.83).

Upward communication appeared to be most frequent (mean=4.04, s.d.=.86), followed by horizontal communication (mean=3.74, s.d.=.93) and downward communication (mean=3.43, s.d.=1.81). Diagonal communication was measured by communication with the head of another department and top executives. Both items were highly correlated ($r=.64$) and summed into an index, with a mean of 2.83 and a standard deviation of .99. Diagonal communication did not happen frequently maybe because some people's jobs did not involve communicating with people on top of the hierarchy.

The respondents agreed that the load of information they had to deal with on a daily basis was "much" (mean=3.97, s.d.=.73), but did not think they had experienced much information overload (mean=2.72, s.d.=.6), suggesting that they could process information relatively efficiently. They perceived electronic mail to be very useful

(mean=6.01 on a 7-point scale, s.d.=1) and easy to use (mean=5.52 on a 7-point scale, s.d.=3.58). They also believed electronic mail has somewhat improved the quality of their work (mean=3.58 on a 5-point scale, s.d.=.83).

Regarding the six dimensions of decision quality, the respondents believed the information they could get to make a decision was somewhat timely and accurate (mean=3.45, s.d.=.64), and they made effective decisions (mean=3.96, s.d.=.47). They often participated in the decision-making process (mean=3.59, s.d.=.64) and were inclined to accept the results of the decision-making process (mean=3.89, s.d.=.49). Although they reported spending more time making nonprogrammed decisions (mean=2.61, s.d.=.53) than programmed decisions (mean=2.25, s.d.=.63), they often made a decision quickly.

Figure 2 depicts the theoretical causal linkages in the model. Since this model is a rather complex one, some variables are organized in a way to minimize the number of links used. To make the presentation of all positive and negative links clearer, they also are organized in table form (p. 118), a "+" meaning a positive link, a "-" meaning a negative links and blanks meaning no hypothesized links.

2. Variables not in the model

Variables not in the model included number of messages received, delegation of use and interactive use of other media, as shown in Table 17. The respondents reported to receive 44 messages per work week, twice as many as messages sent. Perhaps many of them did not require any feedback or follow-up. Since the standard deviation (47.34) was quite large, it was suspected that the number of messages received was more or less inflated. Eighty percent of the respondents handled their own accounts. Among the 37

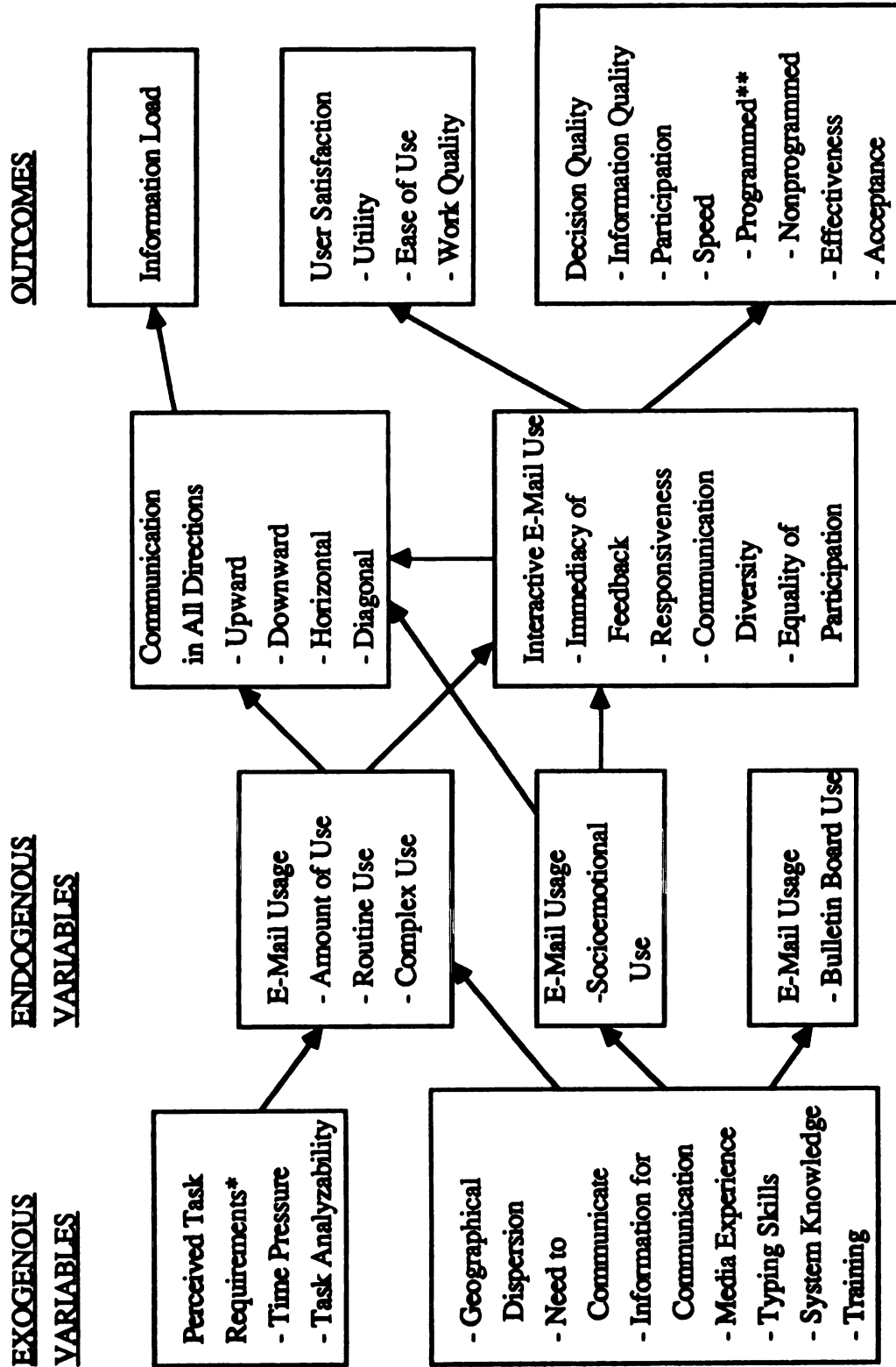


Figure 2: Theoretical Causal Linkages in a Model of E-Mail Use and Its Communication Outcomes

Note: All linkages in the theoretical model are positive except for: * Time pressure is negatively related to e-mail usage and task analyzability is negatively related to amount and complexity of e-mail use; ** Interactive e-mail use is negatively related to speed for making programmed decisions.

Antecedent Variables	Subsequent Variables																						
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
geographic dispersion 1.	+	+	+	+	+																		
time pressure 2.	-	-	-	-																			
task analyzability 3.	-	+	+	+	+																		
need to communicate 4.	+	+	+	+	+																		
information for comm. 5.	+	+	+	+	+																		
media experience 6.	+	+	+	+	+																		
typing skills 7.	+	+	+	+	+																		
system knowledge 8.	+	+	+	+	+																		
training 9.	+	+	+	+	+																		
# of messages sent 10.						+	+	+	+	+	+	+	+										
routine use 11.						+	+	+	+	+	+	+	+										
complex use 12.						+	+	+	+	+	+	+	+										
socioemotional use 13.						+	+	+	+	+	+	+	+										
bulletin board use 14.						+	+	+	+	+	+	+	+										
immed. of feedback 15.										+	+	+	+										
responsiveness 16.										+	+	+	+										
comm. diversity 17.										+	+	+	+										
participation equality 18.										+	+	+	+										
upward comm. 19.										+	+	+	+										
downward comm. 20.														+									
horizontal comm. 21.														+									
diagonal comm. 22.														+									
information load 23.														+									
perceived utility 24.																							
perceived ease of use 25.																							
work quality 26.																							
decision information 27.																							
decision participation 28.																							
speed for prog. dec. 29.																							
speed for nonp. dec. 30.																							
dec. effectiveness 31.																							
decision acceptance 32.																							

Figure 2 (Cont'd)

Summary Statistics for Variables and Scales Not in the Model
Table 17

	Mean	S. D.	Alpha	N
Number of messages received	43.70(wk)	47.34	n/a	191
<u>Behavior related characteristics:</u>				
- other people using e-mail for me	20% yes	80% no	n/a	184
<u>Interactive use of other media:</u>				
- immediacy of feedback	4.04 ^a	.65	.68	191
- responsiveness	3.54 ^b	.71	.84	191
- communication diversity	3.01 ^b	.74	.80	191
- equality of participation	3.49 ^c	.86	.61	191
- ability to terminate	3.66 ^b	.66	.63	191

a: Scale ranged from 1=don't always answer messges/receive feedback to 5=answer/receive the same day.

b: Scale ranged from 1=never to 5=very often.

c: Scale ranged from 1=at all to 5=very much.

respondents who had other people use electronic mail for them, three-fourths used it themselves more than 50% of the time.

Regarding use of media other than electronic mail, the respondents reported that feedback could be received quickly (mean=4.04, s.d.=.65). They did not communicate with a variety of people (mean=3.01, s.d.=.74), but felt their participation was somewhat equal (mean=3.49, s.d.=.86). The general communication process was somewhat responsive (mean=3.54, s.d.=.71) and easy to terminate (mean=3.66, s.d.=.66).

Table 18 shows that how people used other kinds of media were related to how they used electronic mail. The two types of behaviors were consistent ($p < .01$) for the four individual dimensions: immediacy of feedback ($r=.60$), responsiveness ($r=.52$), communication diversity ($r=.40$), and equality of participation ($r=.35$). The findings suggested that media behaviors of organizational members are consistent and their uses of electronic mail and other media complement each other.

Hypothesis Testing

Bivariate correlations were used for hypothesis testing. Since bivariate correlations contain no control, a more accurate assessment of the hypotheses were done by using multiple regressions. Bivariate correlations were compared to partial correlations, which aided in interpreting the magnitude of correlations. Significant reductions in correlations, i.e., partial correlations were not significant at .05 level, suggest spurious relationships between the independent and dependent variables.

Relationships Between Interactive Use of Other Media and Electronic Mail
Table 18

	1	2	3	4	5	6	7	8
Immediacy of feedback - other media 1.	1.00							
Responsiveness - other media 2.	.05	1.00						
Communication diversity - other media 3.	.12	.23	1.00					
Equality of participation - other media 4.	.09	.48	.30	1.00				
Immediacy of feedback - e-mail 5.	.60	.01	.17	-.04	1.00			
Responsiveness - e-mail 6.	.02	.52	.17	.24	.11	1.00		
Communication diversity - e-mail 7.	.18	.14	.40	.10	.16	.37	1.00	
Equality of participation - e-mail 8.	.16	.28	.11	.35	.19	.43	.26	1.00

N=191

Note: The highlighted Pearson r 's are significant at .05 level.

1. Relationships between antecedent factors and usage of electronic mail

The first set of hypotheses involved linear relationships between the nine antecedent factors and five types of e-mail usage, and the results are in Table 19. See Appendix 4-1 for correlations among these 14 variables. Geographical dispersion was hypothesized to be positively related to usage (H1.2.1 - H1.2.5). The results showed that it was significantly related to number of messages sent and routine use (r 's=.22 and .29, respectively).

Geographical dispersion did not appear to be a predictor of complex, socioemotional and bulletin board uses.

Time pressure was hypothesized to be negatively related to number of messages sent and routine and complex uses (H1.3.1 - 1.3.3), but the results were just the opposite (r 's=.25, .19, and .21, respectively). The respondents seemed to think many tasks could be performed efficiently by using electronic mail. On the other hand, task analyzability had no relationships with e-mail usage.

Hypotheses 1.4.1 to 1.4.5 were tested for both perceived need to communicate and enough information for communication. Both were significantly correlated with number of messages sent (r 's=.34 and .24), routine use (r 's=.51 and .36) and socioemotional use (r 's=.15 and .17). Complex use was moderately related to need to communicate (.30), but not information for communication. Information for communication was significantly associated with number of messages sent and routine and socioemotional uses (r 's=.17 - .36), but not with complex use. Both did not appear to have any linear relationships with bulletin board use.

Relationships Between Antecedent Factors and Usage of Electronic Mail
Table 19

<u>Independent Variables</u>	<u>Dependent Variables</u>							
	# of Messages Sent		Routine Use		Complex Use		Socioemotional Use	
	simple r	partial r	simple r	partial r	simple r	partial r	simple r	partial r
Geographical dispersion 1.	.22	.12	.29	.20	.11	.02	-.02	.03
Time pressure 2.	.25	.24	.19	.14	.21	.20		
Task analyzability 3.	.12	.07	.06	-.01	.07	.04		
Need to communicate 4.	.34	.18	.51	.39	.30	.27	.15	.08
Information for comm. 5.	.24	.15	.36	.25	.09	.03	.17	-.03
Media experience 6.	.17	.11	.22	.14	.11	.04	.00	-.11
Typing skills 7.	.23	.22	.23	.20	.10	.07	.17	.01
System knowledge 8.	.16	.08	.14	-.02	.11	-.06	.10	.01
Training 9.	.15	.21	.05	.07	.07	.08	.10	.15

N=191

Note: The simple r's are zero-order Pearson's correlation coefficients and the partial r's are correlation coefficients while holding the remaining independent variables constant. The highlighted ones are significant at .05 level.

Individual experience with electronic mail contributed to number of messages sent (.17) and routine use (.22), but not other purposes of use. Hypotheses 1.5.1 and 1.5.2 were supported, and Hypotheses 1.5.3 to 1.5.5 were not.

Hypotheses 1.6.1 to 1.6.5 involved the skills required to use the particular e-mail system. Skill requirements appeared to have stronger relationships with number of messages sent and routine use, but not with other purposes of use. Typing skills showed positive effects on number of messages sent (.23), routine (.23) and socioemotional (.17) uses. Knowledge of the system encouraged users to send more messages ($r=.16$) and use the system for routine tasks ($r=.14$). Informal training contributed to number of messages sent ($r=.15$) and bulletin board use ($r=.18$).

In general, the antecedent factors explained number of messages sent and routine use better than other purposes of use, maybe because electronic mail was more often used for routine tasks. Electronic mail was not often chosen to perform complex tasks. Perhaps it was used in combination with other media. Unlike findings from previous studies, this study did not find much socioemotional content in e-mail messages. In a study of e-mail use (Steinfeld et. al., 1988), bulletin board use was found to be associated with geographical dispersion, which was not substantiated in this study. Bulletin board use was found to be related only to training. The relationship was significant but not strong (.18).

The theoretical model suggests that amount of use and task-related uses are influenced by all antecedent factors, while socioemotional and bulletin board uses are influenced by all factors but perceived task requirements. Accordingly, the antecedent factors were regressed on each type of usage.¹ Some significant relationships remained significant (at .05 level) after controlling for other independent variables, while others

became insignificant or negligible (see Table 19). Time pressure, need to communicate, information for communication, typing skills and training remained strong predictors of amount of use (partial r 's=.15 - .24). For routine use, its partial correlations with geographical dispersion, need to communicate, information for communication and typing skills were significant (.20 - .39). Both time pressure and need to communicate were still correlated with complex use (partial r 's=.20 and .27). Typing skills became the only factor influencing socioemotional use (partial r 's=.15). For bulletin board use, training remained the only predictor of bulletin board use (partial r =.15).

2. Relationships between usage of electronic mail and interactive e-mail use

The results (see Table 20) supported the hypotheses (H2.1 - H2.4) that interactive use could be attributed to how often and why people used electronic mail. In general, the four dimensions of interactive use were better explained by number of messages sent and task-related uses than by socioemotional use. The number of messages sent and task-related uses were positively related to responsiveness, communication diversity and equality of participation (r 's=.20 - .48). Their relationships with immediacy of feedback were positive but insignificant. Socioemotional use was positively related to responsiveness (.18) and had positive but insignificant relationships with the other three dimensions. The results suggested that communication diversity and equality of participation were more task-oriented.

Types of usage except bulletin board use were hypothesized to influence the four dimensions of interactive use. Four types of usage were regressed on each dimension. Amount of use and task-related uses were still strong predictors of responsiveness (partial r 's=.17 to .29). Both amount of use and routine use contributed to communication

Relationships Between Usage of Electronic Mail and Interactive Use
Table 20

<u>Independent Variables</u>	<u>Dependent Variables</u>							
	Immediacy of Feedback		Responsiveness		Comm. Diversity		Equality of Participation	
	simple r	partial r	simple r	partial r	simple r	partial r	simple r	partial r
# of messages sent 1.	.13	.10	.43	.29	.36	.20	.31	.12
Routine use 2.	.08	.01	.36	.17	.45	.33	.48	.38
Complex use 3.	.07	.02	.34	.21	.20	.06	.24	.12
Socioemotional use 4.	.11	.09	.18	.11	.13	.05	.10	.01

N=191

Note: The simple r's are zero-order Pearson's correlation coefficients and the partial r's are correlation coefficients while holding the remaining independent variables constant. The highlighted ones are significant at .05 level.

diversity (partial r 's=.20 and .33). Routine use showed the strongest partial correlation with equality of participation (.38).

3. Relationships among usage of electronic mail, interactive use and communication in all directions

The findings showed that frequent use of electronic mail increased communication in all directions (r 's=.15 - .29), which supported Hypothesis 3.1. Task-related uses also increased upward (r 's=.22 and .20) and diagonal (r 's=.24 and .17) communication, but not downward and horizontal communication. Interestingly, socioemotional use was negatively related to downward ($r = -.21$) and diagonal ($r = -.15$) communication, and had no relationships with upward and horizontal communication. Thus, hypotheses 3.2 to 3.4 were partially supported. These results are in Table 21.

Table 21 also includes correlation coefficients for interactive e-mail use and communication in all directions. Immediacy of feedback was correlated only with upward communication ($r=.22$). Both responsiveness and communication diversity were related to horizontal and diagonal communication (r 's=.18 - .24). Equality of participation was related to upward (.32) and diagonal (.21) communication. Therefore, electronic mail was more often used to communicate with supervisors and top executives. It seemed that other kinds of media were chosen more often for downward communication than electronic mail. These results partially supported Hypothesis 3.5.

The model further suggests direct effects of usage and interactive use on communication in all directions. See Appendix 4-2 for interrelationships among these variables. Four types of usage and four dimensions of interactive use were regressed on each direction, and the results showed that directions of communication were predicted by

Relationships Among Usage of Electronic Mail, Interactive Use and Communication in all Directions
Table 21

<u>Independent Variables</u>	<u>Dependent Variables</u>			
	Downward Communication	Upward Communication	Horizontal Communication	Diagonal Communication
	simple r	simple r	simple r	simple r
	partial r	partial r	partial r	partial r
# of messages sent 1.	.18	.15	.18	.29
Routine use 2.	.22	.13	.11	.24
Complex use 3.	.20	.00	.10	.17
Socioemotional use 4.	.07	-.21	.05	-.15
Immediacy of feedback 5.	.22	.17	.12	.07
Responsiveness 6.	.14	-.06	.18	.24
Communication diversity 7.	.12	-.02	.18	.24
Equality of participation 8.	.32	.11	.11	.21
				.15
				.07
				.08
				-.24
				.02
				.08
				.10
				.05

N=191

Note: The simple r's are zero-order Pearson's correlation coefficients and the partial r's are correlation coefficients while holding the remaining independent variables constant. The highlighted ones are significant at .05 level.

either usage or interactive use, but not both. Upward communication was better predicted by immediacy of feedback and equality of participation (partial r 's=.17 and .21); its relationships with amount of use and task-related uses became insignificant. For downward communication, socioemotional use still had a negative effect (partial r = -.24). Diagonal communication was affected by amount of use and socioemotional use (partial r 's=.15 and -.24). Neither usage nor interactive use contributed to horizontal communication. The multiple regression results suggested that communication in all directions could be better explained by variables not in the equations. The path analysis results in the next section provided some support for this speculation.

4. Relationships between communication in all directions and information load

The results in Table 22 indicated an increased load of information individuals had to deal with on a daily basis as a result of increased upward, horizontal and diagonal communication (r 's=.20 - .33), but not downward communication. Hypothesis 4.1 was partially supported. The regression results showed that information load was better explained by upward and diagonal communication (partial r 's=.14 and .24).

5. Relationships between media experience and information overload

The findings showed a negative but weak relationship between media experience and information overload. Hypothesis 4.2 was not supported, as presented in Table 23. It is suspected that since the respondents reported a relatively low level of information overload (mean=2.72 on a 5-point scale), media experience became less important in helping people deal with information overload.

Relationships Between Communication in All Directions and Information Load
Table 22

<u>Independent Variables</u>	<u>Dependent Variables</u>	
	<u>Information Load</u> <u>simple r</u>	<u>partial r</u>
Upward communication 1.	.23	.14
Downward communication 2.	.11	.03
Horizontal communication 3.	.20	.08
Diagonal communication 4.	.33	.24

N=191

Note: The simple *r*'s are zero-order Pearson's correlation coefficients and the partial *r*'s are correlation coefficients while holding the remaining independent variables constant. The highlighted ones are significant at .05 level.

The Relationship Between Media Experience and Information Overload
Table 23

<u>Independent Variable</u>	<u>Dependent Variable</u>	<i>p.</i>
	Information overload	
Media experience	-.11	ns
		n=191

6. Relationships between interactive e-mail use and user satisfaction

Users generally reported higher satisfaction when they used electronic mail more interactively. Those who communicated responsively with a variety of people and participated more equally in the process perceived electronic mail to be useful ($r's=.26 - .48$) and easier to use ($r's=.30 - .40$), and reported improvements in their work quality ($r's=.28 - .38$). Immediacy of feedback was related to perceived utility ($r=.20$) and ease of use ($r=.22$), but not work quality. The results are in Table 24 (for relationships among the three measures of user satisfaction, see Appendix 4-3). The multiple regression results showed that communication diversity and equality of participation remained strong predictors of the three measures of satisfaction (partial $r's=.14$ to $.39$). The relationship of responsiveness with ease of use and work quality remained significant (partial $r's=.16$ and $.22$). The partial correlations between immediacy of feedback and the three measures were not significant. Different dimensions of interactive use had various effects on how satisfied users were with the e-mail system and their work.

7. Relationships between interactive e-mail use and decision quality

Table 25 also presents the relationships between interactive e-mail use and decision quality (see Appendix 4-3 for relationships among the six measures of decision quality). In general, interactive use of electronic mail facilitated access to quality information and participation in the decision-making process and slightly improved decision effectiveness. The results partially supported Hypotheses 6.1, 6.2 and 6.5, but not 6.6. All dimensions but immediacy of feedback showed moderate relationships with decision information and participation ($r's=.13 - .34$). None of the dimensions but equality of participation had positive effects on decision effectiveness and acceptance. More equal participation in the communication process helped people make more effective decisions ($r=.16$). Equality of participation also had a weak, positive relationship with decision acceptance. It was

Relationships Between Interactive E-Mail Use and User Satisfaction
Table 24

<u>Independent Variables</u>	<u>Dependent Variables</u>			
	Perceived Utility simple r	Perceived Ease of Use simple r	Perceived Work Quality simple r	partial r
Immediacy of feedback 1.	.20	.22	.12	.04
Responsiveness 2.	.26	.35	.38	.22
Communication diversity 3.	.29	.30	.28	.14
Equality of participation 4.	.48	.40	.36	.21

N=191

Note: The simple r's are zero-order Pearson's correlation coefficients and the partial r's are correlation coefficients while holding the remaining independent variables constant. The highlighted ones are significant at .05 level.

Relationships Between Interactive E-Mail Use and Decision Quality
Table 25

<u>Independent Variables</u>	<u>Dependent Variables</u>									
	Decision Information		Decision Participation		Programmed Decision Speed		Nonprogram. Decision Speed		Decision Effectiveness	
	r	part.I	r	part.I	r	part.I	r	part.I	r	part.I
Immediacy of feedback 1.	.09	.04	.02	-.06	.01	.02	-.04	-.03	.01	-.02
Responsiveness 2.	.13	.02	.24	.09	-.07	-.06	-.10	-.07	.09	.02
Comm. diversity 3.	.16	.10	.15	.04	.00	.04	-.03	.01	.06	.02
Equality of participation 4.	.18	.12	.34	.28	-.08	-.07	-.09	-.05	.16	.13
									-.04	-.08
									.08	.00
									.08	.05
									.14	.12

N=191

Note: The r's are zero-order Pearson's correlation coefficients and the part. r's are correlation coefficients while holding the remaining independent variables constant. The highlighted ones are significant at .05 level.

hypothesized that interactive use would reduce the time it took to make programmed decisions (H6.4.1), but increase the time it took to make nonprogrammed decisions (H6.4.2). Neither was supported by the findings. The weak relationships may be partly attributed to the fact that the respondents did not spend much time making either type of decision. Finally, immediacy of feedback had no effects on any of the six dimensions of decision quality.

The multiple regression results showed that among the four dimensions of interactive use, the only significant partial correlation was between equality of participation and decision participation (.28). The partial correlations of the other three dimensions of interactive use with all measures of decision equality were small.

Path Analysis Results

To reduce the complexity of the model, separate path models were tested for each of the 10 measures of communication outcomes (Variables 23-32, see Figure 2). Within each path model, 14 regression equations were calculated, each of which represents hypothesized relationships among the variables. Each equation was checked for possible violations of assumptions by using residual scatterplots. Each plot was examined in terms of the overall pattern of the scatter, and the residuals appeared to be random. No serious departures from the assumptions were found. In some cases when it was hard to determine the randomness of residuals, regression analyses were conducted for the original and the transformed variables and the multiple correlations for both were compared. No major increases in the multiple correlations for the transformed variables were found, indicating randomness of residuals. Further, Pearson correlations and multiple regressions were run for independent variables in each equation to check for multicollinearity. Neither bivariate nor multiple correlations exceeded .90. Since all independent variables in the

equations were not multicollinear, they were less likely to be singular. Thus, all independent variables in the equations were kept for further analysis.

On the basis of the hypothesized relationships among the variables, an initial model of information load was first tested and diagnosed by entering all hypothesized links and examining the path coefficients of those links. A weak path coefficient indicates the need to drop that particular link. However, there are no clear guidelines as to how small a path coefficient is considered so weak that it should be dropped. Pedhazur's (1982) criterion is used here that all path coefficients equal to or below .05 should be deleted. The deviations between the observed and reproduced correlations, or errors, are then diagnosed; a large deviation suggests the addition of a link. The identification of additional causal antecedents can greatly increase the quality of estimation within the model (Hunter & Gerbing, 1982), but there are no rules regarding how large a deviation is considered so large that a particular link should be added. It was then decided that a link should be added when the value of the deviation is beyond the range of plus and minus 2 standard error from the mean deviation. By adding a link, the sum of squared errors should be reduced, indicating an improvement of the overall fit of the model. Thus, after deleting and adding links, a second model was tested. Because the deletion and addition of links may lead to changes in the magnitudes of the path coefficients retained in the model, the resulting path coefficients of the second model were examined by using the same criteria. The same procedure was repeated till all weak links were dropped and strong links included in the model. The path coefficients in the final model were tested for significance. Because the path coefficients are beta weights, they were examined by testing the beta weights within each regression equation.

For each subsequent model, an initial analysis was done by adding the same added links and removing the same removed links in the first model without the links between

information load and its antecedent variables. All hypothesized links between the dimensions of interactive use and a new outcome variable were also added. The same criteria were used to determine whether the resulting path coefficients should be retained and whether new links should be added. The procedure was repeated till all links met the criteria.

Due to the complexity of the models, the results are presented in table form, instead of diagrams. The following describes the results of the final models, including path coefficients, sum of squared errors, overall chi-square goodness of fit of the model. For each equation, significance tests of beta weights, multiple R and analysis of variance were also reported.² Note that the first 13 (Variables 10-22) of the 14 regression equations for each model yielded the same results. For the equation predicting an outcome variable, see the first right column in each table. The part correlation coefficients, R square and adjusted R square for equations within respective path models are in Appendices 5-1 to 5-10.

1. Information load paths

The theoretical model diagrammed in Figure 2 hypothesizes that perceived task requirements have direct, negative effects and geographical dispersion and personal characteristics have direct, positive effects on amount of use (Variable 10). The data showed that all antecedent factors had positive effects on amount of e-mail use, largely supporting the hypotheses (multiple $R=.53$, $F=7.76$, probability $< .001$). As presented in Table 26, need to communicate ($p=.17$), information for communication ($p=.14$), typing skills ($p=.19$) and training ($p=.18$) showed stronger effects than other antecedent variables. Contrary to the anticipated negative effects, time pressure had the strongest positive effect on amount of use ($p=.23$).

Table 26: Path Coefficients After Deleting Links with No Observed Relationship:

Antecedent Variables	Subsequent Variables	Information Load																	
		10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25		
geographic dispersion 1.	.11	.17																	
time pressure 2.	.23	.11	.20																
task analyzability 3.	.07																		
need to communicate 4.	.17	.36	.27	.08	.07														
information for comm. 5.	.14	.22		.14															
media experience 6.	.10	.11		-.11															
typing skills 7.	.19	.16	.07	.14															
system knowledge 8.	.07																		
training 9.	.18	.06	.08	.10	.16														
# of messages sent 10.																			
routine use 11.								.12	.30	.21	.11		.08	.11	.16	.15			
complex use 12.								.17	.36	.41		.09							
socioemotional use 13.								.20		.10	.14				.08				
bulletin board use 14.								.10	.10										
immed. of feedback 15.																			
responsiveness 16.																			
comm. diversity 17.																			
participation equality 18.																			
upward comm. 19.																			
downward comm. 20.																			
horizontal comm. 21.																			
diagonal comm. 22.																			
information load 23.																			
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.60					
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	35.90					
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001

Note: The highlighted path coefficients are significant within their own regression equations at .05 level.

Path coefficients of added links are italic.

Sum of Squared Errors: 1.31. Overall Chi Square: 123.02, df=155, p. > .90.

All antecedent factors except task analyzability were hypothesized to have positive effects on routine use (Variable 11), and the results largely supported the hypotheses (multiple $R=.63$, $F=17.27$, probability $< .001$). Need to communicate had the strongest effect ($p=.36$), followed by information for communication ($p=.22$), geographical dispersion ($p=.17$) and typing skills ($p=.16$). Time pressure, again, had a positive but weak effect on routine use. Task analyzability and system knowledge had no effects.

Complex e-mail use (Variable 12) was anticipated to be negatively affected by perceived task requirements and positively affected by the remaining antecedent factors. The results partially supported the hypotheses (multiple $R=.37$, $F=7.19$, probability $< .001$). Need to communicate emerged as the strongest predictor of complex use ($p=.27$). Time pressure had a positive effect on complex use ($p=.20$).

Socioemotional e-mail use (Variable 13) was expected to be positively related to geographical dispersion and personal characteristics, which was partially supported by the results. Information for communication ($p=.14$) and typing skills ($p=.14$) were the strongest predictors of socioemotional use. Nevertheless, the relationships were not very strong. Most antecedent factors had no effects on socioemotional use (multiple $R=.26$, $F=3.48$, probability $< .01$).

All antecedent variables except perceived task requirements were expected to be positively related to bulletin board use (Variable 14). The results indicated training as the strongest predictor of bulletin board use ($p=.16$). Need to communicate had a weak, positive effect. Unexpectedly, media experience was negatively related to bulletin board use ($p = -.11$). The data did not provide enough information to speculate why media

experience discouraged such use. Bulletin board use was largely unexplained by the regression model (multiple $R=.21$, $F=2.92$, probability $< .05$).

The next set of hypotheses involved positive linkages between usage of electronic mail and interactive use. E-mail usage except bulletin board use was expected to encourage people to use the system more interactively, which was largely supported by the results. Amount of use and socioemotional use had some weak effects on immediacy of feedback (Variable 15), whose variance was largely unexplained by usage (multiple $R=.17$, $F=2.64$, probability $> .05$). Usage showed the strongest effects on responsiveness (Variable 16). Amount of use ($p=.30$), routine use ($p=.17$) and complex use ($p=.20$) contributed to how responsively people use electronic mail (multiple $R=.52$, $F=17.30$, probability $< .001$). Socioemotional use also slightly increased responsiveness. Communication diversity (Variable 17) was influenced by amount of use ($p=.21$) and routine use ($p=.36$; multiple $R=.49$, $F=29.81$, probability $< .001$). Routine use had a strong effect on equality of participation (Variable 18, $p=.41$), while amount and complexity of use had much weaker effects. The regression model explained 25% of the variance in equality of participation (multiple $R=.50$, $F=21.23$, probability $< .001$).

Communication in all directions was expected to be positively related to usage and interactive use, and it was not hypothesized to be directly affected by the antecedent variables. The results indicated that some antecedent factors had stronger direct effects than usage and interactive use on communication in all directions. Among the use variables, amount of use had the strongest positive effects and socioemotional use the strongest negative effects on communication in all directions except upward communication, which was influenced by various dimensions of interactive use. For upward communication (Variable 19), equality of participation was the strongest predictor of ($p=.24$), followed by

information for communication ($p=.20$), complex use ($p=.14$) and immediacy of feedback ($p=.13$). The regression model explained 18% of the variance in upward communication (multiple $R=.43$, $F=8.19$, probability $< .001$). Socioemotional use ($p=-.20$) and time pressure ($p=.20$) had the strongest effects on downward communication (Variable 20), but in opposite directions. Both amount of use and routine use showed weak relationships with downward communication, whereas interactive use had no effects (multiple $R=.35$, $F=6.31$, probability $< .001$).

For horizontal and diagonal communication, nonmedia-related variables showed stronger relationships than media use variables. Both geographical dispersion ($p=.23$) and bulletin board use ($p=.25$) increased horizontal communication (Variable 21), whereas amount of use and responsiveness had weak effects. Interestingly, experience with electronic mail reduced horizontal communication ($p = -.20$). These five variables combined explained 20% of the variance in horizontal communication (multiple $R=.45$, $F=9.54$, probability $< .001$). Diagonal communication (Variable 22) was influenced by geographical dispersion ($p=.38$), amount of use ($p=.16$) and time pressure ($p=.15$). Socioemotional use had a negative relationship with diagonal communication ($p = -.14$), suggesting people did not communicate nontask-related information with top executives, at least not by electronic mail. The regression model explained 31% of the variance in diagonal communication (multiple $R=.56$, $F=16.54$, probability $< .001$).

Communication in all directions was hypothesized to increase the load of information (Variable 23) organizational members had to deal with on a daily basis, and the results showed that only upward communication had a weak effect on information load. Amount of use had a direct effect on information load ($p=.15$), not an indirect effect as anticipated. People whose jobs involved much time pressure perceived that they dealt with

a great deal of information on a daily basis ($p=.47$). Thirty-six percent of the variance in information load was shared by those three variables (multiple $R=.60$, $F=35.90$, probability $< .001$). With sum of squared errors of 1.31 for all links (retained and missing) and an overall chi square of 123.02 ($df=155$), the probability was greater than .90, indicating that the final model predicting information load fitted the data.

2. User satisfaction paths

It was hypothesized that people would perceive electronic mail to be useful if they used it interactively. The findings in Table 27 showed that equality of participation was a major determinant of perceived utility (Variable 24, $p=.25$), and other dimensions of interactive use had no effects. Routine use appeared to have both direct ($p=.13$) and indirect² effects on perceived utility, but the effects were not very strong. Three media-related personal characteristics also had significant influences. When users believed they needed to use electronic mail ($p=.31$) and had enough information for communication ($p=.13$) and knowledge of the system ($p=.12$), they perceived electronic mail to be very useful. These five variables shared 42% of the variance in perceived utility (multiple $R=.65$, $F=27.79$, probability $< .001$). For the model predicting perceived utility, the probability was greater than .75, with sum of squared errors of 1.36 and an overall chi square of 128.44 ($df=154$), indicating overall fit of the model.

The results largely supported the hypothesis that interactive use had direct, positive effects on perceived ease of using electronic mail (Variable 25, see Table 28). Among the four dimensions of interactive use, equality of participation was the strongest determinant ($p=.23$), followed by responsiveness ($p=.17$), immediacy of feedback ($p=.07$) and communication diversity ($p=.07$). Perceived ease of use was also influenced by media-related personal characteristics: system knowledge ($p=.24$) and information for

Table 28: Path Coefficients After Deleting Links with No Observed Relationship:																	Perceived Ease of Use			
Antecedent Variables	Subsequent Variables																			
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25				
geographic dispersion 1.	.11	.17																		
time pressure 2.	.23	.11	.20																	
task analyzability 3.	.07																			
need to communicate 4.	.17	.36	.27	.08	.07															
information for comm. 5.	.14	.22		.14						.20										
media experience 6.	.10	.11			-.11															
typing skills 7.	.19	.16	.07	.14																
system knowledge 8.	.07																			
training 9.	.18	.06	.08	.10	.16															
# of messages sent 10.						.12	.30	.21	.11											
routine use 11.							.17	.36	.41		.08	.11								
complex use 12.							.20		.10	.14										
socioemotional use 13.																				
bulletin board use 14.						.10	.10													
immed. of feedback 15.																				
responsiveness 16.										.13										
comm. diversity 17.										-.07										
participation equality 18.																				
upward comm. 19.										.24										
downward comm. 20.																				
horizontal comm. 21.																				
diagonal comm. 22.																				
perceived ease of use 25.																				
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45								
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54								
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001								
Note: The highlighted path coefficients are significant within their own regression equations at .05 level.																				
Path coefficients of added links are italic.																				
Sum of Squared Errors: 1.39. Overall Chi Square: 128.66, df=153, p > .75.																				

communication ($p=.18$). The above variables shared 35% of the variance in perceived ease of use (multiple $R=.59$, $F=16.20$, probability $< .001$). With sum of squared errors of 1.39 and an overall chi square of 128.66 ($df=153$), the probability of the whole model was greater than .75. The model fitted the data.

The hypothesis that interactive use of electronic mail will improve work quality (Variable 26) was partially supported by the findings (see Table 29). Only responsiveness had a direct effect on perceived work quality ($p=.13$). People using electronic mail to perform tasks perceived that electronic mail improved their work quality ($p=.13$ for routine use, $p=.16$ for complex use). Need to communicate had a strong effect on work quality ($p=.45$). The four variables explained 44% of the variance in perceived work quality (multiple $R=.66$, $F=36.58$, probability $< .001$). The goodness of fit test indicated overall fit of the model (sum of squared errors=1.30, overall chi square=123.05, $df=155$, probability $> .90$).

3. Decision Quality paths

Interactive use was expected to increase access to quality information that help people make decisions, which was partially supported by the results. As shown in Table 30, only equality of participation ($p=.15$) and communication diversity ($p=.12$) showed positive relationships with decision information (Variable 27). Both variables explained only 5% of the variance (multiple $R=.22$, $F=4.64$, probability $< .05$). No other variables in the whole model had any direct effects on information quality. Several types of e-mail usage had indirect but minimal effects. Although the goodness of fit test indicated overall fit of the model (sum of squared errors=1.33, overall chi square=125.82, $df=157$, probability $> .90$), it did not provide much information about how people got access to quality information.

Table 29: Path Coefficients After Deleting Links with No Observed Relationship:																Perceived Work Quality					
Antecedent Variables	Subsequent Variables																				
	10	11	12	13	14	15	16	17	18	19	20	21	22	26							
geographic dispersion 1.	.11	.17																			
time pressure 2.	.23	.11	.20																		
task analyzability 3.	.07																				
need to communicate 4.	.17	.36	.27	.08	.07																
information for comm. 5.	.14	.22		.14																	
media experience 6.	.10	.11			-.11																
typing skills 7.	.19	.16	.07	.14																	
system knowledge 8.	.07																				
training 9.	.18	.06	.08	.10	.16																
# of messages sent 10.					.12	.30	.21	.11			.08	.11	.16								
routine use 11.						.17	.36	.41	.09												
complex use 12.						.20		.10	.14												
socioemotional use 13.						.10	.10				-.20										
bulletin board use 14.												.25									
immed. of feedback 15.										.13											
responsiveness 16.									-.07		.09			.13							
comm. diversity 17.																					
participation equality 18.									.24												
upward comm. 19.																					
downward comm. 20.																					
horizontal comm. 21.																					
diagonal comm. 22.																					
work quality 26.																					
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.66							
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	36.58							
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001						
Note: The highlighted path coefficients are significant within their own regression equations at .05 level.																					
Path coefficients of added links are italic.																					
Sum of Squared Errors: 1.30 Overall Chi Square: 123.05, df=155, p > .90.																					

The results provided some support for the hypothesis that interactive use of electronic mail increases participation (Variable 28) in the decision-making process as a source of information (see Table 31). Equality of participation was the strongest determinant ($p=.27$), followed by responsiveness ($p=.10$). Downward communication also provided people more opportunities to participate in decision making ($p=.20$). These three variables explained 17% of variance (multiple $R=.41$, $F=12.50$, probability $< .001$). The probability of the whole model predicting participation was greater than .75 (sum of squared errors=1.37, overall chi square=129.47, $df=156$), indicating overall fit of the model.

Interactive use of electronic mail was hypothesized to save time in making programmed decisions (Variable 29) and increase time in making nonprogrammed decisions (Variable 30). The findings showed that interactive use had minimal effects on decision speed. As shown in Table 32, equality of participation slightly reduced the time it took to make programmed decisions ($p=-.08$, $r=.08$, $F=1.35$ probability $> .05$). Both responsiveness ($p=-.08$) and equality of participation ($p=-.06$) slightly reduced nonprogrammed decision time (multiple $R=.11$, $F=1.18$, probability $> .05$, see Table 33). Since the respondents often made a decision quickly, interactive use of electronic mail would not make any difference. The overall chi square was 126.64 ($df=158$, probability $> .90$) for programmed decision speed model and 130.85 ($df=157$, probability $> .75$) for nonprogrammed decision speed model. However, what determined decision time remained unexplained by variables in this study.

Interactive use of electronic mail was expected to help people make effective decisions (Variable 31). Table 34 shows that the data partially supported the hypothesis. Equality of participation was the only dimension of interactive use that had positive effects

Table 33: Path Coefficients After Deleting Links with No Observed Relationship: Speed for Nonprogram. Decisions

Antecedent Variables	Subsequent Variables										Speed for Nonprogram. Decisions									
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
geographic dispersion 1.	.11	.17																		
time pressure 2.	.23	.11	.20																	
task analyzability 3.	.07																			
need to communicate 4.	.17	.36	.27	.08	.07															
information for comm. 5.	.14	.22		.14																
media experience 6.	.10	.11		.11																
typing skills 7.	.19	.16	.07	.14																
system knowledge 8.	.07																			
training 9.	.18	.06	.08	.10	.16															
# of messages sent 10.					.12	.30	.21	.11												
routine use 11.						.17	.36	.41												
complex use 12.																				
socioemotional use 13.							.20	.10	.14											
bulletin board use 14.					.10	.10														
immed. of feedback 15.																				
responsiveness 16.																				
comm. diversity 17.																				
participation equality 18.																				
upward comm. 19.																				
downward comm. 20.																				
horizontal comm. 21.																				
diagonal comm. 22.																				
speed for nonp. dec. 30.																				
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.11						
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	1.18						
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	ns						

Note: The highlighted path coefficients are significant within their own regression equations at .05 level.

Path coefficients of added links are italic.

Sum of Squared Errors: 1.38. Overall Chi Square: 130.85, df=157, p. > .75.

on decision effectiveness ($p=.16$). While time pressure ($p=.23$) was positively related to effectiveness, socioemotional use reduced effectiveness ($p=-.25$). These three variables shared 16% of the variance in effectiveness (multiple $R=.40$, $F=11.76$, probability $< .001$). The probability of the whole model was greater than .90, with sum of squared errors of 1.30 and an overall chi square of 122.90 ($df=156$).

Finally, interactive use of electronic mail was hypothesized to help people accept the final decisions (Variable 32), which was partially supported by the data. Table 35 shows that equality of participation had positive effects on acceptance ($p=.12$), but immediacy of feedback slightly reduced likelihood of acceptance ($p=-.09$). However, time pressure had the strongest relationship with acceptance ($p=.29$). Eleven percent of the variance in acceptance was shared by those three variables (multiple $R=.33$, $F=7.52$, probability $< .001$). For the whole model, the overall chi square was 122.25, ($df=156$, probability $> .90$).

In sum, interactive use of electronic mail presented stronger relationships with user satisfaction than with other communication outcomes. Media-related personal characteristics also helped explained various degrees of satisfaction. For other communication outcomes (e.g., information load and decision quality), perceived task requirements showed strong relationships. Table 36 summarizes the results of path analysis. In this table, only those theoretical linkages that were retained in the path model (i.e., path coefficients that were above .05) were included; unanticipated but observed relationships were excluded. This table demonstrates the significant (highlighted) and insignificant (unhighlighted) relationships within their own equations, with "p" meaning positive and "n" meaning negative. The italic ones depict the direction of observed relationships that was opposite to the hypothesized direction. For example, time pressure

was positively related to e-mail usage, contrary to the anticipated negative relationships. A comparison between these results and the theoretical model in Figure 2 showed how well use of electronic mail impacted on communication outcomes. The implications of these findings, in light of the model in Figure 2 will be discussed in the chapter to follow.

Endnotes

¹ Time pressure and task analyzability were not regressed on socioemotional and bulletin board uses because no relationships were hypothesized.

² For each equation, no more than nine independent variables were used. The ratio of the number of independent variables and the number of cases is 9:191, which should not pose any trouble interpreting the multiple R.

³ The indirect effect of routine use on perceived utility is depicted below:



indirect effect = .10 = .41 x .25.

CHAPTER 6: SUMMARY AND DISCUSSION

This chapter summarizes the results of the path analysis from the preceding chapter in terms of the contribution of each variable to our understanding of e-mail use patterns and their influences. After reviewing the findings, the strengths and weaknesses of the theoretical model are discussed, plus alternative models that can be tested in future research. Based upon this discussion, organizational implications of findings are explored, together with limitations of this study and suggestions for further research.

Previous studies on organizational use of CMC systems have aptly outlined the characteristics of CMC processes, identified the characteristics of CMC systems as compared to earlier modes of communication, and theorized impacts of CMC systems on organizational structure, processes and performance. This study expands on the concept of interactivity, integrates research on media characteristics, and proposes a theoretical model of studying uses of CMC systems. A theoretical model of uses of various CMC systems advances understanding of impacts of microcomputers on organizations in a broader context. After all, different types of CMC systems often coexist in many organizations. This model emphasizes more the similarities than differences among CMC systems. For example, users may choose a system to perform different tasks for various reasons; however, more interactive use of any system provides opportunities to improve communication and performance.

An empirical test of this model is provided in this study. This test focuses on electronic mail for several reasons. Although various types of CMC systems shared many characteristics to a certain degree, e.g., asynchronicity, availability of transcripts,

interactivity, user profiles for various systems seem to be very different. The concentration on a single system provides more accurate evaluations of uses and impacts. Availability, accessibility and prevalence of systems are another consideration. It will be hard to speculate on any impacts of a CMC system before a "critical mass" (Markus, 1987; Rogers, 1986) of people are using it. Electronic mail is the most prevalent CMC system in use. Lastly, it was felt that it was more feasible to examine one system at one time for testing a seemingly complex model. This decision, of course, did not exclude the possibility of examining more than one system at one time or at various times. The purposes of this study are to test the theoretical model, to draw inferences from the data, and to revise the model for further testing. Due to the study's focus on electronic mail, any inferences from the data should be limited to electronic mail, though that is not to say the findings will not provide insights into other CMC systems. The following sections summarize the interrelationships among the variables in the model.

Antecedent Factors

Geographical dispersion (objective task requirements) encouraged frequent, routine use of electronic mail, but it had stronger direct effects on horizontal and diagonal communication, suggesting increased communication was probably a result of frequent use of conventional media such as telephone and/or other newer media such as fax. Both time pressure and task analyzability are considered subjective task requirements. The results indicated strong impacts of time pressure on e-mail use and outcome variables, whereas task analyzability did not show any association with those variables. Contrary to findings of previous studies, the respondents perceived electronic mail to be an efficient medium when constrained by time. Time pressure also had a strong effect on information load. The respondents perceived that they had to deal with a lot of information when they had

limited time to perform a task. Even so, they did not believe they had experienced information overload, at least not often.

Personal characteristics appeared to be strong determinants of uses and perceptions of electronic mail. When individuals were more accessible to others, i.e., with a perceived need to communicate and enough information for communication, that increased e-mail usage. Those people also perceived electronic mail to be useful and easier to use. The results suggested a more important role of perceptions than objective features of electronic mail in determining people's attitudes and behaviors. Use of electronic mail did require certain skills. Typing skills would help people relate electronic mail to other devices requiring the use of a keyboard such as typewriters and word processors. Knowledge of the particular system would not increase usage, but would help people feel more comfortable with the system and develop a positive attitude toward electronic mail in general. This positive attitude may develop into more frequent use in the long run. Informal training from other users encouraged usage. Implied within was the social message from other users, e.g., maybe I should use electronic mail more often since my coworkers are using it so often. Steinfield and colleagues (1988) found that experience with electronic mail increased amount of use and complex use. In this study, experience with electronic mail did not have strong effects on amount of use and no effects on complex use. Since the respondents in this study had much longer media experience, its impact may be reduced in time. Surprisingly, more experienced e-mail users less often engaged in bulletin board use and would not use electronic mail to communication with people holding the same level job as they did. The data failed to provide any explanations for such relationships.

Usage of Electronic Mail

In general, e-mail usage encouraged interactive use, but various types of usage showed different degree of impacts on different dimensions of interactive use. Frequent users often answered messages quickly (immediacy of feedback), were more responsive in the process, established linkages (communication diversity) with others that might not otherwise be available, and enjoyed more equal participation. They seemed to recognize the interactive nature of electronic mail and were simply taking advantage of it. Frequent users also used electronic mail more often to communicate with people working in other departments and top executives. Electronic mail seemed like a logical choice of medium for communication with people in other departments since those people normally were more dispersed than supervisors and subordinates. Frequent users also believed they had to deal with more complex information on a daily basis. Using electronic mail may reduce the use of telephone and memos (Rice & Case, 1983), but increase overall amount of information to be processed. The respondents in this study reported sending 21 and receiving 43 messages per work week, more than reports from previous studies.

Routine use also increased interactive use except for immediacy of feedback. Users thought electronic mail useful for dealing with routine tasks and believed electronic mail had helped them perform routine tasks better. It had also helped people perform complex tasks better. Complex use was positively related to responsiveness and equality of participation. People used electronic mail to discuss complex tasks more often with their supervisors and top executives than with their subordinates. Electronic mail had opened up a new forum for people to communicate with those higher up on the hierarchy. Electronic mail was seldom used for socioemotional purposes, inconsistent with previous findings that electronic mail was often used for socioemotional purposes. But when people did use it to communicate socioemotional messages, they appeared to be responsive. People

especially avoided communicating nontask-related information with their subordinates or top executives. This suggested that a norm might have been developed against social use of electronic mail. Thus, electronic mail might hamper the effectiveness of decisions by frequent socioemotional users. It is speculated that frequent socioemotional users might have less influence on decision-making, or were outcasts in the organization. Further analysis can be done to characterize those users. Bulletin board use was the second most often cited purpose of use, next to routine use. It existed often among people across departments who held the same level job.

Interactive Use of Electronic Mail

The four dimensions of interactive use were significantly correlated with one another, but showed various impacts on communication in all directions, user satisfaction and decision quality. Equality of participation emerged as the most important dimension. It increased upward communication, which is crucial in improving supervisor-subordinate relationships (Ivancevich & Matteson, 1990). Users developed more positive attitudes toward electronic mail (e.g., it's useful; it's easy to operate.) when they could participate in the process more equally. Equal participation increased access to quality information, participation in the decision-making process, effectiveness of their decisions, and the likelihood of accepting the final decision. It also saved a little time in making decisions (both programmed and nonprogrammed). The next critical dimension was responsiveness. The more responsively people used electronic mail, the more often they perceived it easier to use. More responsive use of electronic mail increased horizontal communication and helped people improve their work. Regarding decision quality, responsiveness increased participation and slightly reduced the time it took to make nonprogrammed decisions. Immediacy of feedback increased upward communication, but its impacts on satisfaction

and decisions were negligible. Communication diversity played a somewhat important role in shaping people's perceptions of electronic mail, but would not improve decision quality.

Moreover, the findings showed that people's media behaviors were rather consistent in terms of how interactively they used the media. When people used communication media in an interactive way, they were more likely to use electronic mail more interactively. For each of the four dimensions of interactive use--immediacy of feedback, responsiveness, communication diversity and equality of participation, other media and electronic mail were strongly correlated with each other. The respondents presented variations of interaction while using electronic mail and other media. They got feedback from electronic mail more quickly than from other media, but were less responsive while using electronic mail. They had more communication partners in the computer network and felt more comfortable using electronic mail to express their opinions.

Communication in all Directions

Upward communication (supervisors vs. subordinates) was responsible for part of the increased load of information. Communication in other directions did not exhibit any relationships with information load. An unexpected but not surprising finding was that downward communication increased participation in the decision-making process. It seemed that supervisors could easily solicit opinions about certain decisions from their subordinates through many channels. The findings indicated that electronic mail was one of those channels.

Communication Outcomes

An increased load of information was partly a result of frequent use of electronic mail, but the results suggested that it was largely influenced by task-related variables such as time pressure and upward communication. Since the e-mail system was already in use for several years, it has been incorporated into many people's jobs. Changes in job descriptions or levels would have greater influences on information load than use of a relatively new communication technology. Users claimed to experience little information overload, and experience with electronic mail played a minor role in helping people deal with that problem.

The three measures of user satisfaction were strongly related to one another. They believed electronic mail to be very useful and easy to use. It has helped improve their work quality. The results largely supported the expectation that interactive use of electronic mail increased satisfaction. In fact, interactive use showed stronger impacts on satisfaction than on information load or decision quality. Amount of use and media-related personal characteristics were also associated with satisfaction. Thus, both behaviors and perceptions affected degree of satisfaction.

The six dimensions of decision quality were correlated with one another. Specifically, more access to quality information and greater participation reduced time in making programmed and nonprogrammed decisions and increased effectiveness of decisions. People were more likely to accept the final decisions when they were involved in the decision-making processes and when they believed their decisions were effective. The findings generally supported the notion that decision quality is a multidimensional concept and the dimensions are related to one another. Further, participating in the decision-making process seemed to be very important in making more efficient and

effective decisions. Three dimensions of interactive e-mail use--responsiveness, communication diversity and equality of participation--were positively related to decision participation. Thus, electronic mail has the capability of involving more people, especially people geographically dispersed in the decision-making process. Equality of participation and responsiveness have the potential to increase mutual understanding by allowing participants to enter inputs at any time and to be more responsive to the subject at issue. It seemed that the respondents were indifferent in the kind of decision (e.g., programmed or nonprogrammed) they had to make. What helped reduce decision time remained unexplained by the data.

Impacts of Electronic Mail on Decision-Making

The survey data provided general information about the decision-making process. An open-ended question asked for specific information about how electronic mail has helped improve decision quality. Among the 191 respondents, 83 (43%) described their experience. In a strict sense, electronic mail itself does not have direct effects on decision-making. Instead, use of electronic mail facilitates information processing and exchanging, which, in turn, helps people make better decisions. A few respondents, apparently, failed to differentiate the medium itself and use of the medium, but 90% of those who answered the question said electronic mail did help them make better decisions in many ways.

The most important function of electronic mail, they believed, was that inputs could be solicited from a large number of people, especially those geographically dispersed, in a timely fashion. A large number of inputs often provides more precise evaluations of the issues at hand, which helps people make a decision more rapidly. One respondent said sometimes other people already had solutions to certain problems and the information was not available unless it was solicited. It reduced research time and, of course, decision time.

Organizational members are connected by the computer network; electronic mail provides more access to other people within the network. This involved one characteristic of interactive use--communication diversity. By using electronic mail, not only inputs can be requested easily, but feedback can be received immediately, another characteristic of interactive use.

In addition to getting inputs in a timely fashion, many reported that electronic mail facilitated exchange of information. This is important for decision-making because everyone is kept informed of other people's positions on the issue at hand. Several commented that sufficient information had to be exchanged so that a consensus decision, rather than an authoritative one, could be reached. To them information exchange should be responsive in nature, an interactive use of electronic mail.

Increasing access to information emerged as another function of electronic mail. Information was either requested from other communication partners or retrieved from files. Several believed information retrieval to be very important in making decisions. They often needed information about solutions to previous problems, meetings and other people's positions on certain issues. Information retrieval was important not only in making decisions, but in providing backup for the decisions they have made. Several respondents pointed out that electronic mail made information management easier. Information management includes information storage, filing, retrieval, editing, distribution. The decision-making process generally benefits from the individual's ability to manage information. Some relied more on e-mail's capacity of prompt distribution of information than others. Through electronic mail it was easier to inform other people of new pieces of information pertaining the same problem, new solutions to a problem, the final decision and plans of carrying out the decision. At the same time, people would like to be informed. They did not want to be left out.

Several respondents acknowledged the asynchronous characteristic of the CMC process. Using electronic mail avoids the problem of "telephone tags." Both the sender and receiver of information can enter inputs at their convenience. One observed that in the company many people were slow in returning phone calls, but most people were fast in terms of returning e-mail messages. This observation reveals something about organizational culture. It should not be too surprising to find that employees of a telecommunications company answered e-mail messages promptly when using electronic mail was part of the job description for many of them.

Keeping accurate and permanent accounts of communication is a technical capacity of electronic mail and CMC systems in general. Many respondents considered it crucial. To them sending e-mail messages was a way of documenting conversations, facts or opinions to reduce misunderstanding or clarify positions. It is easier for decision makers to keep track of all information pertaining to a problem. Many considered documentation of conversations as a way of protecting themselves if questions about certain decisions were raised in the future.

Several respondents reported that electronic mail provided them with more control over the communication process in that they could choose the right time and right words to communicate with others. They agreed that electronic mail has the advantage of written communication such as memos, but electronic mail is more convenient and faster. It seemed that using the right words was important for some people. They said the likelihood of misunderstanding or being misunderstood was greater in a telephone conversation than in an e-mail message. Electronic mail, one claimed, had the potential to reduce misunderstanding because an e-mail message was more likely to be thought through so people are less likely to respond with emotions. Since it was written, the receiver "would

be careful and accurate in his/her response." One noted that the most important advantage of electronic mail was that the user has the "ability to pick and choose words to be completely clear." Rapid and precise communication via electronic mail is likely to improve communication and the flow of information. The respondents were able to compare the characteristics of various media and chose the one that they believed would convey both the content and the symbolic meaning of a message.

However, for the same reasons, others insisted that electronic mail decreased the quality of decisions because of lack of physical proximity and interpersonal interaction. They considered electronic mail as impersonal, appropriate only for decisions of low importance. These people preferred engaging in face-to-face or telephone conversations. One complaint was that electronic mail "takes away interpersonal interactions among people." One claimed that "most people can't express themselves properly by using the written word." In this case, the users were still able to identify the characteristics of electronic mail, but weighted those characteristics totally different from those who decided to use the medium.

In sum, these answers provided some evidence to the arguments made earlier about people's media choice and the impacts of such choice on decision-making. Those who used electronic mail interactively reported that such use had improved the quality of their decisions, indicating the validity of the theoretical model.

A Model of Interactive Use of Electronic Mail

The concept of interactive use is originated from a body of research on interactivity. Interactivity is a variable characteristic of the communication process and systems. Rafaeli (1986b, 1988) defined interactivity as participant responsiveness, the extent to which a

communication exchange resembles human discourse. This definition starts from the assumption that human discourse is the ideal and whenever possible, people prefer face-to-face interaction to any other kinds of communication. Whether a communication technology is appropriate for certain communication needs depends on how closely the communication process brought about by the technology resembles face-to-face interaction. These assumptions failed to recognize the situation where participants often use different media for different reasons to fulfill various communication needs.

An expansion of Rafaeli's definition, Williams, Rice and Rogers' (1988) definition of interactivity is the extent to which participants have control over, and can exchange roles in, their mutual discourse. Implied within are the same assumptions adopted by Rafaeli. Their major contribution to a broader definition is to examine interactivity from the participant point of view. They discussed interactivity in terms of the amount of control participants have over the communication process. In particular, participants would want to control the timing, content and sequence of a communication act.

Heeter (1986) clearly stated that interactivity is a multidimensional concept and developed six dimensions for the concept. They include: the complexity of choice available, effort requirements, responsiveness, capability of monitoring system use, ease of adding information and capability of facilitating interpersonal communication. The last dimension shares the same assumptions with previous studies. Other dimensions seem to involve characteristics of the medium or of the user. It is unclear how each dimension contributes to the general understanding of interactivity.

In this study, it is argued that interactivity should be conceptualized as the amount of control participants have over the communication process and the degree of access

participants have to others. Control means participants decide how they communicate with others, whereas access to others implies access to information. This definition incorporates previous studies of interactivity, but does not assume that face-to-face interaction is the ideal. It is up to the participants to decide how they fulfill their communication needs. Thus, it is more appropriate to consider interactivity as a variable characteristic of communication behavior. It is argued that interactivity is a desired quality of communication behavior that varies among individuals. It is further argued that organizational members make sense of their environments, perform tasks and make decisions by taking control over the way they communicate with others. By taking control over the communication process, they can have more control over the outcomes of communication acts such as decision-making. To distinguish this definition from the previous ones, the term "interactive use" is utilized.

The concept of interactive use also adopts the viewpoint of the media characteristics perspective that users are able to recognize the characteristics of certain media. But previous studies of media characteristics seem to regard all characteristics as of equal importance. This study argues that people weight different characteristics differently. The various dimensions of interactive use should appeal to users differently based upon their communication needs. This argument was supported by the five resulting dimensions of interactive use of other media. Some dimensions such as equality of participation were perceived to be more important than others. Immediacy of feedback, responsiveness, equality of participation and ability to terminate are related to how much control participants have over the communication process, whereas communication diversity indicates how much access participants have to others. Communication diversity was a composite of source diversity and communication linkages. It seemed that participants were indifferent in whether they were the source or receiver of a message. Often times they could be either

or both. The most important point was that participants were linked together by one or more media.

All dimensions of interactive use except ability to terminate emerged from e-mail use. Ability to terminate failed to emerge as a dimension partly because of measurement error; inappropriate items were developed to measure the construct. Since the CFA program is sensitive to sample size and the number of items measuring the same construct, further research on the dimensions, obviously, should focus on developing more items for each dimension. Nevertheless, the data provided evidence that interactive use was a valid concept of communication behavior.

The formulation of a causal model of interactive e-mail use was to examine its relationships with other e-mail use constructs from the literature and to evaluate its impacts on communication outcomes. This enables us to assess the role of interactive use as an important part of organizational communication behavior. The theoretical model is a rather complex one because many variables are examined at the same time. One advantage is that one is able to examine the interrelationships of determinants of e-mail use and outcomes. However, one disadvantage of this approach is that it is still an underspecified model, meaning there are still many variables left out of the analysis. Also, a complex model does not necessarily provide better explanations as to what causes people to use a system and what results from such use. An empirical test of the model by using path analysis indicated that many links had to be dropped due to lack of observed relationships and others had to be added because of unexpected, strong relationships. An examination of the final model showed that many linkages retained in the model were still relatively weak in terms of explaining causal effects. In some cases when the overall models fitted the data, they did

not provide enough information to comprehend the determinants of some outcomes such as decision speed.

It seems that the next logical step is to test a series of smaller models, instead of one large model. For example, task and nontask-related uses can be tested in separate models. Another approach is to establish new linkages by using the results of this study. For example, a key to improving supervisor-subordinate relationships is to stimulate upward communication. One can examine the impacts of interactive use of electronic mail on upward communication and the impacts of increased upward communication on participation in the decision-making process and the impacts of such participation on making effective decisions. A third approach is to focus on a few variables and add a new outcome variable. The data have established strong relationships between interactive use and user satisfaction. One can examine if these relationships lead to overall job satisfaction. By testing a series of relevant models, one may acquire better knowledge of interactive use of electronic mail and its correlates.

Limitations

One major limitation is that the data were collected at one time within one company. One is unable to make comparisons at different points in time (e.g., three months and one year after implementation). Fortunately, this study does not concern the implementation or acceptance of new CMC systems, but the use of a CMC system as one of the media available to organizational members. There was no control group in the research design. Although post hoc within-group comparisons are still possible, it should not be construed as a substitute for *a priori* hypothesis testing (Pedhazur, 1982).

With a 20% response rate, any inferences from the findings about the company as a whole should be cautious. Because of the low response rate of in-house surveys (about 25%), a higher response rate was not anticipated. The concern is the difference, if any, between those who answered the questionnaire and those who did not. It was speculated that the respondents might be more enthusiastic e-mail users than the nonrespondents, though the profile of the respondents (in Table 3) did not exhibit any extremely or unreasonably skewed distributions.

Another limitation is the lack of objective measures of work and decision quality. Although perceptions are important and the respondents indicated better work and decision quality accompanied by the use of electronic mail, it is uncertain how using electronic mail can actually increase efficiency or improve productivity. At best, the results suggest that electronic mail has the potential to improve communication and performance.

The relatively small sample ($n=191$) has posed problems for some measures. The CFA program is sensitive to the size of sample and the number of items measuring the same construct. To keep the questionnaire within a workable length, it was decided that only three items would be developed to measure each construct.¹ Both have made the initial CFA results difficult to interpret because one cannot be certain if an offending item is an inadequate measure or a result of sampling error. When the offending item was dropped, one measure was often left with two items, making tests of internal consistency impossible. This problem occurred more often for measures of interactive use and decision quality than for other measures. There seems to be a simple explanation. While those measures were tested for the first time, other measures (e.g., e-mail usage and perceived utility) had been tested repeatedly in other studies.

Moreover, some variables were measured by one item. These variables may suffer great error of measurement that cannot be offset by other items. When more than one item is used, they can be summed into a cluster (scale) score; then the errors tend to cancel out so there is less error in a cluster score than in an item (Hunter & Gerbing, 1982). However, when individual items are very noisy and when the number of items in the cluster is small, the amount of error in the cluster score can still be large. This is probably a close description for some scales whose reliability scores were below .80. Thus, further research should address the validity and reliability of unidimensional scales by using more items for each measure and a larger sample.

Regarding the questionnaire, the respondents had problems answering some questions. One of them asked the percent of time other people use the e-mail system for the respondent. Eleven percent of the respondents either left it blank or put down a question mark, a clear indication of incomprehension. Although a technique was used to deal with the missing data, as described in Chapter 4, this item was excluded from correlation and regression analysis. In addition, the respondents were obviously confused by questions with reverse wording, which was manifested by the CFA results. Reversely worded questions were designed in the hope of getting meaningful answers. With or without reverse worded questions, it would be difficult to determine if the answers were meaningful. The questionnaire failed to provide a definition of coworker, as pointed out by one respondent. What was included on the first page of the questionnaire was a definition of people with whom the respondent regularly works. In later pages, they were referred to as coworkers. There were no reasons to assume that somehow the respondents would make the connection. Although this should not pose serious problems, the presence of a definition would help the respondents form an answer.

Implications of Study Findings

The findings have important ramifications for the study of organizational use of CMC systems in general and electronic mail in particular. An expansion of the concept of interactivity, interactive use of electronic mail is a new concept for researchers to explore. The results confirmed the notion that interactive use is a multidimensional concept. Some dimensions were more important than others. For example, equality of participation had direct impacts on many of the outcome variables. Although ability to terminate failed to emerge as a dimension, it was probably due to measurement error, not conceptual limitations since the dimension emerged for use of other media. Characterized by the control over communication process and access to communication partners, interactive use can provide more accurate assessments of organizational media behavior. In other words, the concept of interactive use attempts to tap "how" people use interactive media, as compared to previous studies of "what" was used and "why" it was used.

The result that interactive use of electronic mail could potentially improve performance should appeal to organizations. Electronic mail can be used to perform tasks and make decisions when face-to-face (or other modes of communication) is unavailable or undesired. Positive outcomes can be anticipated when users start taking control over the way they communicate with others. Interactive use appeared to increase upward communication, which is crucial in improving mutual understanding between supervisors and subordinates, suggesting that interactive use can improve communication. Interactive use did not appear to increase unnecessary communication, which is a positive sign for organizational members since interactive use seems to increase redundancy in communication. Based upon the results, organizations can develop strategies to encourage interactive use to achieve some predetermined outcomes.

Regarding dimensions of decision quality, access to quality information and greater participation in decision-making increase decision effectiveness. Organizational measures can be taken to ensure decision makers relevant and timely information and inputs from individuals.

Use of CMC systems requires more skills than use of conventional media; skills such as typing obtained from using conventional media can help people feel more comfortable with CMC systems. The results also suggest that in order to operate a CMC system properly, users need knowledge of the particular system in use. Training is also desired and even informal training from other users is very helpful. Hughes publishes a VAX/E-MAIL user guide and updates it regularly. It was a little surprising that many respondents did not know such user guide existed, let alone making reference to it. A simple solution is to "broadcast" an e-mail message to every user that a copy can be obtained from the publication office.

Accessibility of individuals to others appeared to be an important factor in determining e-mail usage and user satisfaction. Accessibility of individuals involves perceptions,² and positive attitudes toward electronic mail encourage usage. Moreover, the positive attitudes lead to positive evaluations of the system and their work. Organizations can reinforce the importance of being accessible to others. When people use electronic mail more frequently to perform tasks, it saves them time and energy (e.g., many face-to-face meetings can be replaced by electronic meetings.) so they can devote their time to more important matters.

Future Research

The concept of interactive use presents a promising research direction. This concept can be applied to other types of interactive media such as teleconferencing. One might expect various degrees of interactive use of different media. Users may weight each dimension differently when using different media. Interactive use also can be examined at the group level. One might expect improved group communication and better group decisions. The impacts of interactive use should be examined in more specified terms. For example, decision quality should be examined by both objective and subjective measures.

The conceptual model also provides opportunities for future research. One approach is to take several significant paths to establish a simpler model so one can conduct in-depth examination of a limited number of variables at one time. Another approach is to dissect the model and examine a number of models at one time. One can also examine a different set of outcome variables. At the group level, one can examine changes in group relations, including consensus, leadership emergence and coalition formation, as a result of interactive use. At the organizational level, changes in organizational structure and the impacts of such changes can be examined.

Researchers can examine media choice by studying uses of several interactive media. For example, electronic mail is often used in combination with fax. Variability of interactive use of different media can be investigated.

Objective measures should be developed for the outcome variables, including information load, work and decision quality. These measures should provide more reliable information as to the impacts of electronic mail and/or other CMC systems.

Another way to examine the interactive use of CMC systems is to take advantage of their capacity to keep permanent accounts of communication. Network analysis can be performed. A number of methods can be combined to collect data. For example, both self reports and machine reports can be obtained. Many researchers have started using both forms of reports. This approach can be applied to studies of interactive use. Longitudinal data can be obtained to investigate impacts of interactive use over time.

Finally, more research efforts should focus on interorganizational communication via CMC systems, along with intraorganizational communication. Many researchers have pointed out that need, but more interorganizational studies are yet to come. By viewing each organization as an environment, its interaction with other environments becomes crucial. Do interactive communication technologies play an important role in organizational survival? Researchers should be able to address this issue.

Conclusions

The most important finding of this study is that interactive use is a valid concept. It is a variable characteristic of media behavior. Individuals are able to identify the characteristics of a medium and recognize its capacity to convey data and symbolic meaning. They are willing to take control over the communication process and be connected with a large number of communication partners.

Interactive use of electronic mail can improve organizational communication. It has strong impacts on user satisfaction and moderate impacts on decision quality. Expanded from the concept of interactivity, interactive use appears to be promising in examining media behavior with additional refinements.

Endnotes

¹ In a few cases, more than three items were developed to measure one construct.

² Originally, accessibility of individuals was conceptualized to include behavior and perceptions. In this study, most respondents checked for incoming messages more than twice a day, meaning that most were willing to make themselves available for communication. The item was dropped from further analysis. However, this item might have some impacts on usage if the respondents did not uniformly check for messages more than twice a day.

APPENDICES

Appendix 1: A Proposal to Hughes Network Systems

**Ms. Linlin Ku
School of Journalism
Michigan State University
East Lansing, MI 48824**

November 20, 1991

**Mr. John D. McClanahan
Vice President
Hughes Network Systems
Germantown, MD 20874**

Dear Mr. McClanahan:

I am writing to you to explore the possibility of doing a field study at your company as part of my doctoral dissertation project.

This project focuses on the impacts of electronic mail use on organizational communication. The primary research concern is whether increased access to quality information and an increased flow of communication, made available via E-mail, improve work and decision quality. Research results should provide management with useful information on this issue.

The implementation of an electronic messaging system such as E-mail involves costs of money, time, and human resources. The company as a whole and its individual members would want to benefit from services the system provides. Specifically, E-mail has the potential to improve productivity and the proposed study will provide some insights into how E-mail use may contribute to productivity. Although individual use of E-mail is the target of this study, research findings may suggest implications for strategic planning by the company.

The research plan would be carried out in the following manner:

- 1) I need to visit the site to understand the system features and general communication environment;**
- 2) I need to interview at least one middle or top manager to have some general ideas about how the system is being used;**
- 3) An initial questionnaire will be pretested with individuals and then revised;**
- 4) A list of all E-mail users in the company will be created; the revised questionnaire will be distributed to a sample derived from that list;**
- 5) The questionnaire will be distributed through the company E-mail system; and**
- 6) Follow-up E-mail will be sent to stimulate response rate.**

This study will not interfere in day-to-day operation of the company. The personal interview should take no more than one hour, and it will take 10 to 15 minutes to complete the questionnaire on the E-mail system. I will also assure the confidentiality of the company and of the individuals.

E-mail users included in this study will be notified of the forthcoming survey, and that it is endorsed by the company. We will briefly explain the study's purpose and elaborate on that after the questionnaires have been completed.

I hope I have given you sufficient information about this project, which I believe, will benefit your company as well. Should you need further information, please do not hesitate to call me (my phone #: 517-355-7989 and fax #: 517-355-7999). If I have not heard from you, I will call you in two weeks to discuss the potential of this project.

Your consideration of this matter will be appreciated.

Sincerely,

Linlin Ku

Appendix 2: A Site Visit to Hughes Network Systems

January 22, 1992

TO: Professors Bradley Greenberg, Steve Lacy, Lucinda Davenport, & Chip Steinfield

FROM: Linlin Ku

SUBJECT: A report on my visit to Hughes Network Systems

I visited Hughes in Germantown, Maryland, on Dec. 19, 1991, interviewed several managers, engineers and secretaries, and had lunch with John McClanahan, vice president, at its cafeteria. The following is a summary of what I learned about the company and its e-mail system.

Hughes Network Systems, a subsidiary of Hughes Aircraft, uses an in-house Vax e-mail system. It connects its offices and plants in Germantown, San Jose, San Diego, and H&S Limited in United Kingdom. The system is connected to internet so employees may have international communication partners. However, international communication accounts for only a small percentage of e-mail use, which is done mainly for internal purposes.

The total number of its employees is estimated at 2,000, with 60% in the Germantown location, where seven buildings are connected to each other. Almost every employee has an e-mail account and password to sign on; every employee has a terminal except those working in the plant. Those who don't have a terminal have access by going to another department. Terminals double as PCs. I was provided with a list of 1085 user names, which can be used as the sampling frame. Each department houses one printer with a preset page limit. Each user can create his/her own distribution list. Although no one is able to send out anonymous messages, I don't know if someone within the company monitors message content. Each user has his/her own exclusive mail folder, which protects user's privacy because others cannot open that folder, but it doesn't always guarantee confidentiality.

When the Vax e-mail system was first installed about five years ago, all secretaries were offered training sessions and others attended those sessions at their own discretion. Newcomers are supplied with a handbook and quick reference guide, which are regularly updated. On-line help is also available. In addition, newcomers can always go to people like Mary Ann Slack, who is in charge of maintaining the e-mail system, for help. Slack told me that the company encourages employees to use e-mail by providing easy access and by continuously making it easier to use. Her remarks were confirmed by other people.

When I asked Slack to speculate on the reasons people use e-mail, she said that executives and administrators use e-mail largely for communication purposes, while attributing engineers' use to personal interests. Although we did not agree on a definition of an active user, she considered herself one. After I talked to several other users who also considered themselves active users, it

became clear that on a typical work day, a typical active user spends from 1 to 1.5 hours to respond to 15 to 20 messages. It doesn't include the time it takes to do some research before certain messages can be returned. The case may be a bit different for secretaries. About half of the managers answer their own e-mail, while the other half let their secretaries do that. Some secretaries answer e-mail for more than one manager, so they hardly have time to send out their own messages.

Slack and I discussed the possibility of using e-mail to conduct the survey. I was concerned about the length of the questionnaire. She said it can be done, but if it requires users to put in more effort answering the questionnaire, people are more likely to stop in the middle or not to answer it at all. We both, then, agreed that it would be easier to provide users with a hard copy.

Most people I interviewed showed positive attitudes toward e-mail, which helps eliminate many memos and phone calls. They also save time on xeroxing documents. One secretary told me that she looks at e-mail as legal documentation of conversation. She also said using e-mail doesn't increase her work load because it's part of her job. One manager, Tim Green, specifically said e-mail is not appropriate for negotiation. He told me that there were instances where people, trying to get the job done quickly, deliberately used e-mail to avoid face-to-face communication. For him it was irritating and it happens almost everyday.

There are other things that irritate people. There is also an internal voice mail system. In Germantown, fewer than 200 people are equipped with voice mail, but people who don't have a voice mail account can still leave a message. Several people complained that a number of people use voice mail to screen calls, making communication more difficult.

A reception area in each building is equipped with an electronic bulletin board. Administrators decide on what goes on the board. The company also has a video conferencing room. Video conferencing is frequently used for internal and corporate meetings.

Both Green and McClanahan characterized their management style as participatory. Workers are not unionized, the labor-management relationship is smooth and turnover rate is especially low. McClanahan attributed the low turnover rate to competitive salaries and good fringe benefits. Green said during the past 10 years there was only one small-scale layoff.

As I walked around, the work environment seemed informal and friendly. Employees looked energetic and enthusiastic. I felt Hughes is a proper research site. Should you have questions about that trip, please let me know. Your comments are especially welcomed.

Appendix 3: Cover Letter, Questionnaire and Follow-up Announcement

Dear HNS employee:

You have been selected to participate in an electronic mail survey, which focuses on your use of the internal VAX/E-MAIL system. This survey serves as part of my doctoral dissertation project.

Your participation is completely voluntary, but your responses will be valuable for individual users and this company as a whole. It takes approximately 20 minutes to complete this questionnaire, and all your responses will be kept strictly confidential.

Please answer all questions as accurately as possible and return your questionnaire in an interoffice mail envelope to Linlin Ku, c/o Pam Huber, D-107. You do not have to return this letter as well.

If you have any questions about this survey, I can be reached at (301) 490-8236. If you are interested in the results of this survey, please put your name and address on the space below and return this letter, separately, to: Ms. Linlin Ku, School of Journalism, Michigan State University, East Lansing, MI 48824. I'll contact you as soon as initial results become available.

Thank you for your cooperation.

Sincerely,

Linlin Ku

	strongly disagree	disagree	neutral	agree	strongly agree
<u>How much do you agree or disagree with the following statements?</u>	<i>(circle the one best response for each)</i>				
I really need to use EM to communicate with other people.	1	2	3	4	5
I am satisfied with the internal EM user guide.	1	2	3	4	5
I am not satisfied with the on-line help on EM system.	1	2	3	4	5
I don't always have enough information to communicate with other people through EM.	1	2	3	4	5
I have received a lot of informal training from other EM users.	1	2	3	4	5

II. THE PURPOSES OF MY ELECTRONIC MAIL USE

	never	seldom	sometimes	often	very often
<u>I use EM for the following purposes:</u>	<i>(circle the one best response)</i>				
exchanging routine information with others	1	2	3	4	5
keeping in touch with someone in another location	1	2	3	4	5
sending notes that contain social or non-work related content	1	2	3	4	5
keeping track of company news	1	2	3	4	5
coordinating project activities	1	2	3	4	5
sharing opinions	1	2	3	4	5
resolving conflicts/disagreements	1	2	3	4	5
negotiating	1	2	3	4	5
getting to know someone	1	2	3	4	5
sending information to a large number of people	1	2	3	4	5
scheduling meetings	1	2	3	4	5
reading bulletin board information	1	2	3	4	5

III. MY PERCEPTIONS OF ELECTRONIC MAIL

What are your general feelings about using electronic mail? Mark X on the space that best describes your feelings about EM.

EM is:	1	2	3	4	5	6	7
useful	_____	_____	_____	_____	_____	_____	useless
fast	_____	_____	_____	_____	_____	_____	slow
unnecessary	_____	_____	_____	_____	_____	_____	necessary
difficult	_____	_____	_____	_____	_____	_____	easy
simple	_____	_____	_____	_____	_____	_____	complex
comfortable	_____	_____	_____	_____	_____	_____	uncomfortable
inefficient	_____	_____	_____	_____	_____	_____	efficient
convenient	_____	_____	_____	_____	_____	_____	inconvenient

IV. MY WORK QUALITY WITH ELECTRONIC MAIL

	strongly disagree	disagree	neutral	agree	strongly agree
<u>Do you agree or disagree:</u>	-----				
	<i>(circle the one best response)</i>				
Using EM has greatly improved the quality of my work.	1	2	3	4	5
Using EM has greatly improved the quality of my department's work.	1	2	3	4	5
E-mail has not made it easier to do my own work.	1	2	3	4	5

V. MY ELECTRONIC MAIL INTERACTION WITH OTHER PEOPLE

How do you interact with other people in the company by using electronic mail?

	same day	next day	within a week	within 2 weeks	don't always return messages
I usually answer other people's EM	1	2	3	4	5
If an EM message needs some research before it can be answered, I usually answer that message	1	2	3	4	5

	same day	next day	within a week	within 2 weeks	don't always receive feedback
I usually receive other people's feedback to my EM messages	1	2	3	4	5

	never	seldom	sometimes	often	very often
	<i>(circle the one best response)</i>				
I start topics of discussion in my EM.	1	2	3	4	5
Other people respond to the subjects I start.	1	2	3	4	5
I respond to other people's inputs to my earlier EM message.	1	2	3	4	5
I receive EM containing the same information from different people.	1	2	3	4	5
I receive EM from people I don't personally know.	1	2	3	4	5
I receive EM from people I know who are not my coworkers.	1	2	3	4	5
I send EM to people I regularly talk with face-to-face.	1	2	3	4	5
I send EM to people with whom I often communicate over the phone.	1	2	3	4	5
I send EM to people I know who are not my coworkers.	1	2	3	4	5
I send EM to people I don't personally know.	1	2	3	4	5
I send others brief EM messages, e.g., 1 or 2 lines.	1	2	3	4	5
I write EM messages, but don't send them.	1	2	3	4	5
I send others long EM messages, e.g., 3 or more paragraphs.	1	2	3	4	5

	not at all	little	some	much	very much
	<i>(circle the one best response)</i>				
I feel comfortable sending EM to my supervisor.	1	2	3	4	5
I feel pressured sending EM to the company's top executives, e.g., VPs, CEO.	1	2	3	4	5
I feel comfortable using EM to give my opinions to others about a topic under discussion.	1	2	3	4	5

VI. MY GENERAL INTERACTION WITH OTHER PEOPLE

Besides electronic mail, how do you interact with other people in the company by using other ways of communication (e.g., face-to-face, telephone, or memos)?

	never	seldom	sometimes	often	very often
	<i>(circle the one best response)</i>				
I start topics of discussion.	1	2	3	4	5
Other people respond to the subjects I start.	1	2	3	4	5
I respond to other people's inputs to my earlier message.	1	2	3	4	5
I receive the same information from different people.	1	2	3	4	5
I receive memos or phone calls from people I don't personally know.	1	2	3	4	5
I receive phone calls or memos from people I know who are not my coworkers.	1	2	3	4	5
I phone people I regularly talk with face-to-face.	1	2	3	4	5
I send memos to people with whom I often communicate over the phone.	1	2	3	4	5
I communicate with people I know who are not my coworkers.	1	2	3	4	5
I communicate with people I don't personally know.	1	2	3	4	5
I make brief phone calls (i.e., 3 minutes or less) to other people.	1	2	3	4	5
I write short memos (i.e., 1 or 2 lines) to others.	1	2	3	4	5
I have brief face-to-face conversations (i.e., 3 minutes or less) with other people.	1	2	3	4	5
	not at all	little	some	much	very much
I feel comfortable communicating with the company's top executives (e.g., VPs, CEO) about a topic under discussion.	1	2	3	4	5
I feel pressured when communicating with my supervisor.	1	2	3	4	5
I feel comfortable giving opinions at any time to others about a topic under discussion.	1	2	3	4	5

	same day	next day	within a week	within 2 weeks	don't always return messages
	<i>(circle the one best response)</i>				
I usually answer other people's messages	1	2	3	4	5
If a message needs some research before it can be answered, I usually return that message	1	2	3	4	5
	same day	next day	within a week	within 2 weeks	don't always receive feedback
I usually receive other people's feedback to my messages	1	2	3	4	5

VII. CHARACTERISTICS OF MY JOB

	not at all	little	some	much	very much
<u>My job involves:</u>					
time pressures	1	2	3	4	5
tasks with clearly defined outcomes	1	2	3	4	5
crises, urgent matters	1	2	3	4	5
the need for rapid decision	1	2	3	4	5
tasks with standard procedures	1	2	3	4	5
well-defined subject matter	1	2	3	4	5

VIII. MY GENERAL COMMUNICATION WITH OTHER PEOPLE

(Note: Leave items blank that are not applicable to you.)

	never	seldom	sometimes	often	very often
<u>I communicate with the following people:</u>					
my supervisor	1	2	3	4	5
my subordinates	1	2	3	4	5
people in other departments who have the same level job as I do	1	2	3	4	5
the head of another department	1	2	3	4	5
top executives (e.g., VPs, CEO)	1	2	3	4	5

IX. THE LOAD OF INFORMATION I GENERALLY DEAL WITH

<u>How much do you agree or disagree</u>	strongly disagree	disagree	neutral	agree	strongly agree
	<i>(circle the one best response)</i>				
I have to handle a great deal of information almost everyday.	1	2	3	4	5
I usually handle complex information.	1	2	3	4	5
I receive a lot of junk mail.	1	2	3	4	5
I usually do not respond to certain inputs.	1	2	3	4	5
I usually need other people's help with complex information before responding.	1	2	3	4	5
I don't always respond accurately when handling a great deal of information.	1	2	3	4	5
I usually spend a lot of time studying information before responding.	1	2	3	4	5
I usually can handle information as rapidly as I want to.	1	2	3	4	5

X. MY DECISION-MAKING PROCESS

<u>How much do you agree or disagree:</u>	strongly disagree	disagree	neutral	agree	strongly agree
	<i>(circle the one best response)</i>				
The quality of information I'm able to get in order to make a decision is timely.	1	2	3	4	5
I participate in the decision-making process as a source of information.	1	2	3	4	5
It takes me a lot of time to make a decision that has no standard procedures to follow.	1	2	3	4	5
It's hard for me to accept decisions that have already been made.	1	2	3	4	5
I feel pressured into agreeing with others while a decision is being made.	1	2	3	4	5
I can make a routine decision quickly.	1	2	3	4	5
The quality of information I can get in order to make a decision is accurate.	1	2	3	4	5

	strongly disagree	agree	neutral	disagree	strongly disagree
	<i>(circle the one best response)</i>				
I spend a lot of time making a decision that has an established procedure to follow.	1	2	3	4	5
I have difficulties in agreeing with others about how a decision should be made.	1	2	3	4	5
The information I can get in order to make a decision is not always relevant.	1	2	3	4	5
✓ I spend a lot of time making a decision that requires creative thinking.	1	2	3	4	5
I give advice about how a decision should be made.	1	2	3	4	5
✓ I'm satisfied with the quality of my decisions.	1	2	3	4	5
I'm consulted by other people before a decision is made.	1	2	3	4	5
I tend to agree with other people about how a decision should be made.	1	2	3	4	5
I make effective decisions.	1	2	3	4	5
I spend little time making a decision that has standard procedures to follow.	1	2	3	4	5
I accept the result once a decision is made.	1	2	3	4	5
It takes me little time to make decisions that require innovative solutions.	1	2	3	4	5
The quality of my department's decisions is not satisfactory.	1	2	3	4	5
I tend to accept a decision when I've been involved in the decision-making process.	1	2	3	4	5

Give an example of how electronic mail has helped improve your decision quality:

XI. BACKGROUND INFORMATION

The one category which best describes my job is:

(check one only)

- ☐ 1) marketing/account management
☐ 2) programming
☐ 3) engineering
☐ 4) public relations
☐ 5) systems operations
☐ 6) training

- ☐ 7) planning
☐ 8) research
☐ 9) clerical
☐ 10) finance/accounting
☐ 11) personnel
☐ 12) other _____

(please specify)

My level in the company is:

(check one only)

- ☐ 1) non manager
☐ 2) first level supervisor
☐ 3) middle management
☐ 4) upper management

I have worked for this company for:

(number of years)

My age is:

(number of years)

The highest level of education I have is:

(check one only)

- ☐ 1) less than high school diploma
☐ 2) high school diploma
☐ 3) some college
☐ 4) undergraduate degree
☐ 5) master's degree
☐ 6) Ph.D.

My gender is:

- ☐ 1) male
☐ 2) female

THANK YOU VERY MUCH!

Please use the space below or the back of this page for any comments you may have about this study.
 Return the completed questionnaire to: Linlin Ku, c/o Pam Huber, D-107, Hughes Network Systems,
 11717 Exploration Lane, Germantown, MD 20874.

Follow-up Announcement

Dear HNS employee:

A survey of electronic mail use is being conducted in the company. You should have received a questionnaire a couple of weeks ago. Your participation, while completely voluntary, would be useful in getting better knowledge of how people use electronic mail and how electronic mail can help improve performance.

Please answer all questions as accurately as possible and return the questionnaire to Linlin Ku, c/o Pam Huber, D-107. Contact Ms. Huber for a copy of the questionnaire should you not have one.

If you have returned your questionnaire, we thank you for your cooperation.

Sincerely,

Linlin Ku

Appendix 4-2: Relationships Between Usage of Electronic Mail, Interactive Use and Communication in All Directions

	1	2	3	4	5	6	7	8	9	10	11	12
# of messages sent 1.	1.00											
Routine use 2.	.42	1.00										
Complex use 3.	.27	.26	1.00									
Socioemotional use 4.	.09	.17	.16	1.00								
Immediacy of feedback 5.	.13	.08	.07	.11	1.00							
Responsiveness 6.	.43	.36	.34	.18	.11	1.00						
Communication diversity 7.	.36	.45	.20	.13	.16	.37	1.00					
Equality of participation 8.	.31	.48	.24	.10	.19	.43	.26	1.00				
Upward communication 9.	.18	.22	.20	.07	.22	.14	.12	.32	1.00			
Downward comm. 10.	.15	.13	.00	-.21	.02	.09	.03	.11	.11	1.00		
Horizontal comm. 11.	.18	.11	.10	.05	.12	.18	.18	.11	.25	-.05	1.00	
Diagonal communication 12.	.29	.24	.17	-.15	.07	.24	.24	.21	.24	.29	.33	1.00

N=191

Note: The highlighted Pearson r's are significant at .05 level.

Appendix 4-3: Relationships Between Interactive E-Mail Use and Communication Outcomes

	1	2	3	4	5	6	7	8	9	10	11	12	13
Immediacy of feedback 1.	1.00												
Responsiveness 2.	.11	1.00											
Communication diversity 3.	.16	.37	1.00										
Equality of participation 4.	.19	.43	.26	1.00									
Perceived utility 5.	.20	.26	.29	.48	1.00								
Perceived ease of use 6.	.22	.35	.30	.40	.61	1.00							
Perceived work quality 7.	.12	.38	.28	.36	.52	.28	1.00						
Decision information 8.	.09	.13	.16	.18	.12	.18	.06	1.00					
Decision participation 9.	.02	.24	.15	.34	.09	.06	.21	.29	1.00				
Programmed dec. time 10.	.01	-.07	.00	-.08	.06	-.02	.05	-.09	-.15	1.00			
Nonprogram. dec. time 11.	-.04	-.10	-.03	-.09	-.03	-.02	.05	-.17	.21	.17	1.00		
Decision effectiveness 12.	.01	.09	.06	.16	.00	.00	.03	.26	.30	-.23	-.35	1.00	
Decision acceptance 13.	-.04	.08	.08	.14	.00	-.08	.06	.03	.15	-.19	-.02	.27	1.00

N=191

Note: The highlighted Pearson r's are significant at .05 level.

Appendix 5-1: Part Correlation Coefficients for Regression Equations in the Model: Information Load																				
Antecedent Variables	Subsequent Variables																			
	10	11	12	13	14	15	16	17	18	19	20	21	22	23						
geographic dispersion 1.	.11	.16																		
time pressure 2.	.24	.11	.21																	
task analyzability 3.	.06																			
need to communicate 4.	.15	.33	.26	.08	.06															
information for comm. 5.	.13	.20		.13																
media experience 6.	.09	.11																		
typing skills 7.	.19	.16	.10	.14																
system knowledge 8.	.07																			
training 9.	.18	.06	.08	.09	.15															
# of messages sent 10.						.12	.26	.19	.10		.06	.10	.15	.17						
routine use 11.							.15	.33	.36		.09									
complex use 12.																				
socioemotional use 13.							.19		.10	.13										
bulletin board use 14.						.10	.09													
immed. of feedback 15.																				
responsiveness 16.										.13										
comm. diversity 17.																				
participation equality 18.																				
upward comm. 19.										.21										
downward comm. 20.																				
horizontal comm. 21.																				
diagonal comm. 22.																				
information load 23.																				
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.60						
R Square	.28	.40	.13	.07	.04	.03	.27	.24	.25	.18	.12	.20	.31	.37						
Adjusted R Square	.24	.37	.12	.05	.03	.02	.26	.23	.24	.16	.10	.18	.29	.36						
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	35.90						
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001						

Appendix 5-2: Part Correlation Coefficients for Regression Equations in the Model: Perceived Utility of Electronic Mail																			
Antecedent Variables	Subsequent Variables																		
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				
geographic dispersion 1.		.11	.16																
time pressure 2.		.24	.11	.21															
task analyzability 3.		.06																.22	.36
need to communicate 4.		.15	.33	.26	.08	.06											.19		.13
information for comm. 5.		.13	.20		.13					.18									.26
media experience 6.		.09	.11		-.11													-.19	.12
typing skills 7.		.19	.16	.10	.14														
system knowledge 8.		.07																	
training 9.		.18	.06	.08	.09	.15													.11
# of messages sent 10.						.12	.26	.19	.10		.06	.10	.15						
routine use 11.						.15	.33	.36	.09										.09
complex use 12.						.19		.10	.13										.07
socioemotional use 13.						.10	.09												
bulletin board use 14.																			
immed. of feedback 15.																		.25	
responsiveness 16.										.13									
comm. diversity 17.										-.06								.07	
participation equality 18.										.21									
upward comm. 19.																			.21
downward comm. 20.																			
horizontal comm. 21.																			
diagonal comm. 22.																			
perceived utility 24.																			
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.65					
R Square	.28	.40	.13	.07	.04	.03	.27	.24	.25	.18	.12	.20	.31	.43					
Adjusted R Square	.24	.37	.12	.05	.03	.02	.26	.23	.24	.16	.10	.18	.29	.41					
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	27.79					
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001					

Appendix 5-3: Part Correlation Coefficients for Regression Equations in the Model: Perceived Ease of Using Electronic Mail

Antecedent Variables	Subsequent Variables	10	11	12	13	14	15	16	17	18	19	20	21	22	25
geographic dispersion 1.		.11	.16												
time pressure 2.		.24	.11	.21									.22	.36	
task analyzability 3.		.06										.19		.13	
need to communicate 4.		.15	.33	.26	.08	.06									
information for comm. 5.		.13	.20		.13						.18				.16
media experience 6.		.09	.11												
typing skills 7.		.19	.16	.10	.14										
system knowledge 8.		.07													
training 9.		.18	.06	.08	.09	.15									.23
# of messages sent 10.							.12	.26	.19	.10		.06	.10	.15	
routine use 11.								.15	.33	.36		.09			
complex use 12.								.19		.10	.13			.07	
socioemotional use 13.							.10	.09							
bulletin board use 14.															
immed. of feedback 15.															
responsiveness 16.											.13		.25		.06
comm. diversity 17.															
participation equality 18.															
upward comm. 19.															
downward comm. 20.															
horizontal comm. 21.															
diagonal comm. 22.															
perceived ease of use 25.															
Multiple R		.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.59
R Square		.28	.40	.13	.07	.04	.03	.27	.24	.25	.18	.12	.20	.31	.35
Adjusted R Square		.24	.37	.12	.05	.03	.02	.26	.23	.24	.16	.10	.18	.29	.32
F =		7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	16.20
p.		<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001

Antecedent Variables	Subsequent Variables										Perceived Work Quality									
	10	11	12	13	14	15	16	17	18	19	20	21	22	26						
geographic dispersion 1.	.11	.16																		
time pressure 2.	.24	.11	.21																	
task analyzability 3.	.06																			
need to communicate 4.	.15	.33	.26	.08	.06															
information for comm. 5.	.13	.20	.13																	
media experience 6.	.09	.11		.11																
typing skills 7.	.19	.16	.10	.14																
system knowledge 8.	.07																			
training 9.	.18	.06	.08	.09	.15															
# of messages sent 10.						.12	.26	.19	.10		.06	.10		.15						
routine use 11.						.15	.33	.36			.09			.11						
complex use 12.						.19		.10	.13					.07	.14					
socioemotional use 13.						.10	.09													
bulletin board use 14.																				
immed. of feedback 15.																				
responsiveness 16.										.13										
comm. diversity 17.										-.06				.12						
participation equality 18.																				
upward comm. 19.										.21										
downward comm. 20.																				
horizontal comm. 21.																				
diagonal comm. 22.																				
work quality 26.																				
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.66						
R Square	.28	.40	.13	.07	.04	.03	.27	.24	.25	.18	.12	.20	.31	.44						
Adjusted R Square	.24	.37	.12	.05	.03	.02	.26	.23	.24	.16	.10	.18	.29	.43						
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	36.58						
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001						

Appendix 5-5: Part Correlation Coefficients for Regression Equations in the Model: Decision Information																					
Antecedent Variables	Subsequent Variables																				
	10	11	12	13	14	15	16	17	18	19	20	21	22	27							
geographic dispersion 1.		.11	.16																		
time pressure 2.		.24	.11	.21																	
task analyzability 3.		.06																			
need to communicate 4.		.15	.33	.26	.08	.06															
information for comm. 5.		.13	.20	.13																	
media experience 6.		.09	.11							.18											
typing skills 7.		.19	.16	.10	.14																
system knowledge 8.		.07																			
training 9.		.18	.06	.08	.09	.15															
# of messages sent 10.						.12	.26	.19	.10		.06	.10	.15								
routine use 11.						.15	.33	.36	.36		.09										
complex use 12.						.19		.10	.13												
socioemotional use 13.						.10	.09														
bulletin board use 14.																					
immed. of feedback 15.																					
responsiveness 16.										.13											
comm. diversity 17.										-.06		.07									
participation equality 18.										.21											
upward comm. 19.																					
downward comm. 20.																					
horizontal comm. 21.																					
diagonal comm. 22.																					
decision information 27.																					
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.22							
R Square	.28	.40	.13	.07	.04	.03	.27	.24	.25	.18	.12	.20	.31	.05							
Adjusted R Square	.24	.37	.12	.05	.03	.02	.26	.23	.24	.16	.10	.18	.29	.04							
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	4.64							
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.05							

Appendix 5-6: Part Correlation Coefficients for Regression Equations in the Model: Decision Participation																				
Antecedent Variables	Subsequent Variables																			
	10	11	12	13	14	15	16	17	18	19	20	21	22	28						
geographic dispersion 1.		.11	.16																	
time pressure 2.		.24	.11	.21																
task analyzability 3.		.06																	.22	.36
need to communicate 4.		.15	.33	.26	.08	.06					.19								.13	
information for comm. 5.		.13	.20																	
media experience 6.		.09	.11	.13						.18										
typing skills 7.		.19	.16	.14	-.11														-.19	
system knowledge 8.		.07																		
training 9.		.18	.06	.08	.09	.15														
# of messages sent 10.						.12	.26	.19	.10		.06	.10	.15							
routine use 11.						.15	.33	.36			.09									
complex use 12.							.19		.10	.13									.07	
socioemotional use 13.						.10	.09				-.19								-.14	
bulletin board use 14.																				
immed. of feedback 15.												.25								
responsiveness 16.										.13										
comm. diversity 17.										-.06		.07								.09
participation equality 18.																				
upward comm. 19.										.21										.25
downward comm. 20.																				.20
horizontal comm. 21.																				
diagonal comm. 22.																				
decision participation 28.																				
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.41						
R Square	.28	.40	.13	.07	.04	.03	.27	.24	.25	.18	.12	.20	.31	.17						
Adjusted R Square	.24	.37	.12	.05	.03	.02	.26	.23	.24	.16	.10	.18	.29	.15						
F	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	12.50						
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001						

Appendix 5-7: Part Correlation Coefficients for Regression Equations in the Model: Speed for Programmed Decisions

Antecedent Variables	Subsequent Variables																			
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
geographic dispersion 1.		.11	.16																	
time pressure 2.		.24	.11	.21																
task analyzability 3.		.06																		
need to communicate 4.		.15	.33	.26	.08	.06														
information for comm. 5.		.13	.20	.13						.18										
media experience 6.		.09	.11		-.11															
typing skills 7.		.19	.16	.10	.14															
system knowledge 8.		.07																		
training 9.		.18	.06	.08	.09	.15														
# of messages sent 10.						.12	.26	.19	.10		.06	.10	.15							
routine use 11.						.15	.25	.33	.36		.09									
complex use 12.						.19	.19		.10	.13			.07							
socioemotional use 13.						.10	.09													
bulletin board use 14.																				
immed. of feedback 15.																				
responsiveness 16.										.13										
comm. diversity 17.										-.06										
participation equality 18.																				
upward comm. 19.										.21										
downward comm. 20.																				
horizontal comm. 21.																				
diagonal comm. 22.																				
speed for prog. dec. 29.																				
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.08						
R Square	.28	.40	.13	.07	.04	.03	.27	.24	.25	.18	.12	.20	.31	.01						
Adjusted R Square	.24	.37	.12	.05	.03	.02	.26	.23	.24	.16	.10	.18	.29	.01						
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	1.35						
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	ns						

Appendix 5-8: Part Correlation Coefficients for Regression Equations in the Model: Speed for Nonprogrammed Decisions																				
Antecedent Variables	Subsequent Variables																			
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
geographic dispersion 1.		.11	.16																	
time pressure 2.		.24	.11	.21																
task analyzability 3.		.06																		
need to communicate 4.		.15	.33	.26	.08	.06														
information for comm. 5.		.13	.20	.13						.18										
media experience 6.		.09	.11		-.11															
typing skills 7.		.19	.16	.10	.14															
system knowledge 8.		.07																		
training 9.		.18	.06	.08	.09	.15														
# of messages sent 10.						.12	.26	.19	.10		.06	.10	.15							
routine use 11.																				
complex use 12.						.15	.33	.36	.36		.09									
socioemotional use 13.						.19			.10	.13			.07							
bulletin board use 14.						.10	.09				-.19	.25	-.14							
immed. of feedback 15.																				
responsiveness 16.										.13										
comm. diversity 17.									-.06		.07		-.07							
participation equality 18.										.21										
upward comm. 19.																				
downward comm. 20.																				
horizontal comm. 21.																				
diagonal comm. 22.																				
speed for nonp. dec. 30.																				
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.11						
R Square	.28	.40	.13	.07	.04	.03	.27	.24	.25	.18	.12	.20	.31	.01						
Adjusted R Square	.24	.37	.12	.05	.03	.02	.26	.23	.24	.16	.10	.18	.29	.01						
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	1.18						
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	ns						

Appendix 5-9: Part Correlation Coefficients for Regression Equations in the Model: Decision Effectiveness																				
Antecedent Variables	Subsequent Variables																			
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
geographic dispersion 1.		.11	.16																	
time pressure 2.		.24	.11	.21																
task analyzability 3.		.06																		
need to communicate 4.		.15	.33	.26	.08	.06														
information for comm. 5.		.13	.20	.13																
media experience 6.		.09	.11		.11					.18										
typing skills 7.		.19	.16	.10	.14															
system knowledge 8.		.07																		
training 9.		.18	.06	.08	.09	.15														
# of messages sent 10.						.12	.26	.19	.10		.06	.10	.15							
routine use 11.						.15	.33	.36		.09										
complex use 12.						.19			.10	.13			.07							
socioemotional use 13.						.10	.09													
bulletin board use 14.																				
immed. of feedback 15.																				
responsiveness 16.										.13										
comm. diversity 17.																				
participation equality 18.																				
upward comm. 19.										.21										.16
downward comm. 20.																				
horizontal comm. 21.																				
diagonal comm. 22.																				
dec. effectiveness 31.																				
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.40						
R Square	.28	.40	.13	.07	.04	.03	.27	.24	.25	.18	.12	.20	.31	.16						
Adjusted R Square	.24	.37	.12	.05	.03	.02	.26	.23	.24	.16	.10	.18	.29	.15						
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	11.76						
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001						

Appendix 5-10: Part Correlation Coefficients for Regression Equations in the Model: Decision Acceptance																				
Antecedent Variables	Subsequent Variables																			
	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
geographic dispersion 1.	.11	.16																		
time pressure 2.	.24	.11	.21																	
task analyzability 3.	.06																			
need to communicate 4.	.15	.33	.26	.08	.06															
information for comm. 5.	.13	.20		.13																
media experience 6.	.09	.11			-.11															
typing skills 7.	.19	.16	.10	.14																
system knowledge 8.	.07																			
training 9.	.18	.06	.08	.09	.15															
# of messages sent 10.						.12	.26	.19	.10		.06	.10	.15							
routine use 11.							.15	.33	.36		.09									
complex use 12.							.19		.10	.13										
socioemotional use 13.																				
bulletin board use 14.						.10	.09													
immed. of feedback 15.																				
responsiveness 16.										.13										
comm. diversity 17.										-.06		.07								
participation equality 18.																				
upward comm. 19.										.21										
downward comm. 20.																				
horizontal comm. 21.																				
diagonal comm. 22.																				
dec. acceptance 32.																				
Multiple R	.53	.63	.37	.26	.21	.17	.52	.49	.50	.43	.35	.45	.56	.33						
R Square	.28	.40	.13	.07	.04	.03	.27	.24	.25	.18	.12	.20	.31	.11						
Adjusted R Square	.24	.37	.12	.05	.03	.02	.26	.23	.24	.16	.10	.18	.29	.09						
F =	7.76	17.27	7.19	3.48	2.92	2.64	17.30	29.81	21.13	8.19	6.31	9.54	16.54	7.52						
p.	<.001	<.001	<.001	<.01	<.05	ns	<.001	<.001	<.001	<.001	<.001	<.001	<.001	<.001						

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