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Computer networking among faculty members: the effects of computer networking on faculty communication and culture

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Computer networking among faculty members: The effects of computer networking on faculty communication and culture

by

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CHAPTER I. INTRODUCTION

Background for Study

In November of 1988, a computer virus stalled academic research nationwide. The virus infected the Internet computer network which links some 500,000 researchers and faculty members to each other as well as to the U. S. Department of Defense and the National Science Foundation. Due to the virus, academics were halted in their practice of using the network to "collaborate, share research results, and send and receive information about meetings and conferences" (Turner, 1989b, p. A18). By February of 1989, CERT (Computer Emergency Response Team) had been created to rally the expertise of 100 computer networking experts from across the country in the event of another such crisis (Turner).

According to Congress' Office of Technology Assessment, Congress needs to spearhead a National Research and Education Network designed to link academics at various universities to each other and to advanced remote computers so that "the current 'piecemeal' development of the network by public and private organizations is integrated, strengthened, and directed to meet national priorities" (Turner, 1989c, p. A19). The report entitled "High Performance Computing and Networking for Science" stated that American scientists should be able to use their computers to:

- Communicate with researchers worldwide.
- Run data through powerful computers elsewhere.
- Gain access to collections of software to support their research, and to specialized data bases.
- Use remote experimental apparatus -- "telescopes, environmental monitoring devices, [and] seismographs."
- Use 'digital libraries' where all books, journals, and other materials are in

electronic form and the information can be searched and manipulated.

- Use specialized facilities to display the results of their experiments and calculations 'in a more readily understandable and visualizable ways.'

(Turner, p. A19)

Both of these recent events describing problems and possible solutions pertaining to the use of computer networks by university and college faculty members across the United States, provide evidence for the increasing importance of computer networking in higher education. At an increasing rate, faculty members are using computer networking to communicate within campuses, between campuses, and between campuses and other external organizations (Bogucki, 1987). For example, by the end of the 1987-88 academic year, 40 of the 52 prestigious universities of the Consortium of Liberal Arts Colleges had connected to national computer networks-- a 50% increase from the previous year (Turner, 1989a).

Growth in the use of computer networking in higher education becomes even more interesting considering the impact that it may have upon the manner in which faculty members communicate with each other. According to Langenberg (1989) "no technology has had and will continue to have as powerful an effect on scholarship as our discovery of how to transmit information electromagnetically" (p. 12). Computer networking has become another medium which faculty members may use in their communication process. Many scholars have described the communicative tasks faculty members accomplish via computer networking (Barden & Golden, 1986; Fuchs,1983; Greenberger, Aronofsky, McKenney,& Massy, 1974; Heisler, 1988; Hiltz & Turoff 1978; King, 1988; McCredie & Timlake, 1983; Pierce & Cooley, 1985; Slatta, 1987).

Accomplishing these communicative tasks by utilizing computer networking, has caused faculty members to change their level of use of more traditional faculty media like the telephone, mail, conferences, and journals. Hiltz (1984) concluded that at low levels of system use, computer networking is likely to have an add-on effect; while at higher levels of system use, computer networking is likely to expand the use of other media.

Computer networking has also affected the quantity of interaction between faculty members. Many researchers agreed that computer networking increases the connectivity of its users (Freeman & Freeman, 1980; Hiltz, 1981; Hiltz & Kerr, 1981; Hiltz & Turoff, 1978, 1985; Johansen, Vallee,. & Spangler, 1979; Kerr & Hiltz, 1982; Palme, 1981; Panko & Panko, 1981; Rice, 1980a; Vallee, Johansen, Lipinski, Spangler, Wilson, 1978). Bezilla and Kleiner (1980) and Bezilla (1979) found computer networkers experience an exponential growth in the connectivity of their professional and social circles due to continuous interaction with previously developed contacts and with a number of new links from new networks.

Because communication is so closely related to culture, a change in faculty communication due to computer networking may affect faculty culture. Geertz (1973) and Schall (1983) contended that the culture of an organization such as a university is the collective beliefs, assumptions, rules, customs and practices of its members. The means and products of such mutually shared organizational cultures is the social interaction between organizational members (Chaffee & Tierney, 1988; Clark, 1983; Hall, 1959; Pacanowsky & O'Donnell-Trijillo, 1982). When such communication between organizational members increases, Pickett and Sorenson (1983) found that organizational members more likely shared a perspective of organizational culture. To assess cultural consensus, Harris and Cronen (1979) adapted Kelly's (1955) personal construct theory into the notion of "master contract" which includes the constructs, beliefs, and ideal states organizational members create and share. Communication facilitates master contract-making between organizational members and the master contract guides and determines collective behavior.

When considering cultural changes in faculty cultural, a unique aspect of the higher education context also must be considered. The role of "faculty member" includes simultaneous membership in two major groups: the discipline and the institution (Becher, 1987; Casanova, 1987; Clark, 1987b; Freedman, 1979; Kuh & Whitt, 1988; Metzger, 1987; Ruscio, 1987). Therefore, a study looking at change in faculty culture, must explore change in faculty members' disciplinary culture and institutional culture.

Statement of the Problem

The problem inherent with the growing utilization of computer networking in higher education is the effect it may have on faculty communication and on the disciplinary and institutional cultures faculty members share. If indeed, more faculty members are using computer networking to communicate with each other, and if indeed computer networking increases faculty communication, it is essential to explore what effects computer networking may have on shared disciplinary and/or institutional cultures. A dramatic and imbalanced increase in the communication between only those faculty members who use computer networking, may facilitate the factioning of cultures within the discipline and/or the institution. Because communication effects culture, these newly established electronic communication cliques may alter the way computer networkers view their discipline and/or their institution. This view of the discipline and/or institution may significantly differ from those faculty members who rarely or do not use computer networking. Thus subgrouping within the discipline and/or the institutional department may occur.

The research done on the effects of computer networking on scientific communication, has studied communication between scientists from varied disiciplines. Because disciplines vary on the amount and type of communication (Becher, 1987), research like this study which focuses upon only one discipline will allow for control of extraneous disciplinary factors. In addition, although much research has been conducted on the effects communication technologies have on interaction, Hiemstra (1986) argued that research now needs to be done on the way these technologies affect the inter subjective worlds of its users. Since technologies like computer networking "affect the transmission of symbols and meaning, the revolution in information technology has the potential to alter the culture of an organization profoundly" (Hiemstra, p. 874). Changes in shared disciplinary and institutional cultures brought on by computer networking's effects to communication quantity may be assessed by tapping and comparing faculty members' master contracts. Since faculty members are simultaneously members of both their discipline and their institution, it is important to explore the changes in master contract -making with both their academic disciplines and higher education institutions.

Therefore, the focus of this investigation is to examine the influences computer networking has on faculty communication and to explore how computer networking affects faculty culture by comparing the master contract-making (with their discipline and their institution) of faculty members who use computer networking greatly with those who use it rarely or not at all.

Statement of the Purpose

In this study, faculty members from various research universities I who are members of the astronomy discipline were surveyed to determine how computer networking affects various aspects of their communication and the culture of their discipline and institutions. Faculty members were surveyed to determine their level of computer networking. Faculty members were asked via a survey to report their uses for computer networking, the changes in use of traditional faculty communication media due to computer networking, and the changes in the amount of colleague communication due to computer networking. In addition, differences in the shared disciplinary and institutional cultures of high, moderate, and low level computer network users were examined. To determine differences in faculty culture, high, moderate, and low level computer network users were compared on the way they make master contracts with their discipline and institution. Master contract components examined included: constructs used to define their discipline and institution and the beliefs held on the actual and ideal states of the discipline and institution.

The Iowa State University Committee on the Use of Human Subjects in Research reviewed this project and concluded that the rights and the welfare of the human subjects were adequately protected, that risks were outweighed by the potential benefits and expected value of the knowledge sought, that confidentiality of data was assured and that informed consent was obtained by appropriate procedures.

Definition of Terms

The terms used in this study may be defined as follows:

Computer networking: the use of a computer to create, store, and distribute text files and data bases within and between groups of individuals and organizations. This includes any of the the following types of human communication via computers: electronic mail, electronic bulletin boards, computer conferencing, and integrated office support systems (Beckwith,1987; Hiltz & Kerr, 1986).

Computer networker: one who uses computer networking

Faculty members: fulltime researchers and teachers at colleges or universities in the United States.

Institutions: any organization in the United States whose mission is to provide postsecondary education.

Disciplines: "language communities" (Kuhn, 1970) or "fields of inquiry" (Reither,

1986) which discipline members use to mutually create and share assumptions on what is knowledge, how is it created, what is quality academic performance, and what is professional interaction and publication (Kuh & Whitt, 1988).

Variables

The variables addressed in the study were: (a) faculty members' communicative uses of computer networking (b) usage of traditional faculty communication media (c) quantity of colleague communication (d) master contract-making toward the discipline, and (e) master contract-making toward the institution.

Research Questions

This study asked the following research questions:

1. What types of communication tasks do faculty members who use computer networking to communicate with other discipline members located at other institutions accomplish via computer networking?

2. How does the use of computer-networking by faculty members to communicate with other discipline members located at other institutions affect their use of traditional faculty communication media?

3. How does the use of computer-networking by faculty members to communicate with other discipline members located at other institutions affect the quantity of their communication with local and distant colleagues?

4. How does the use of computer-networking to communicate with other discipline members located at other institutions affect master contract-making with the discipline?

5. How does the use of computer-networking to communicate with other discipline members located at other institutions affect master contract-making with the institution?

Statement of Assumptions

The first assumption is that there is a critical mass of faculty members using computer networking to communicate with members of their discipline so as to justify a study.

The second assumption is that the American professoriate consists of more than one culture. In essence, the study assumes that faculty members are simultaneously members of both a discipline culture and an institutional culture.

The third assumption is that although this present study focuses upon interaction of faculty members from higher education institutions, in reality, faculty are members of much broader "scientific communities" involving persons both within and outside of higher education (as in private and government research facilities). Therefore, previous research done on scientific communities can not be generalized fully to the higher education environment; however because faculty members are a part of this larger community, it is pertinent and helpful.

Limitations of the Study

Although many researchers agreed that faculty members simultaneously hold institutional and discipline membership, faculty members are also simultaneously members of other service, political, and external organizations. This study focused on only the institutional and discipline organizations.

Although many faculty members are currently using computer networking to communicate with members of their own institutions and other external organizations, this study focused solely upon those faculty members using computer networking to communicate with members of their disciplines who are employed at different universities.

Also, many disciplines consist of sub-groups. This study approached a somewhat narrow discipline in a general manner. Additional research should be done on the sub-groups within disciplines.

Computer networking encompasses a variety of activities including electronic mail, computer conferencing, electronic bulletin boards, and integrated office support systems. In order to obtain a broad idea of how all of these types of humans communicating with other humans via computers affects higher education, this study does not focus on just one of these activities. Instead it studied faculty members who may be using one or all of these types of computer networking to communicate with members of their discipline. If use of one type of computer networking may affect the academic profession differently from another, this study did not account for or attempt to measure these differences.

Unlike computer networking systems like EIES and PLANET (which were designed to research the effects of communicating via a computer networking system), the computer networking system used by subjects in this study is not a finite set and thus it is very difficult to monitor interactions via a computer. For example, some subjects communicate with each other via one computer network while others may be communicating via another and possibly incompatible system (AAS, 1989a). Therefore, self-reports were used to obtain data on the level of computer networking usage . Although self-reports provide the researcher with an idea of subjects' behaviors, they are sometimes distorted by memory and researcher bias. Conclusions reached from this research are suggestive not confirmatory.

Due to the grounded approach of developing the survey used in this study to measure perceptual differences of subjects, this study identifies the level of subjects' computer networking usage at two points in time separated by two months. Because some differences in reported level of computer networking appeared from time one to time two and because the literature reveals evidence for cycles in faculty communication, this study is limited by its lack of longitudinal data.

Significance of the Study

According to Pettibone and Roddy (1987), the use of computer networking by faculty members is growing. Such an innovation in the communication behaviors of faculty members is important to both higher education researchers as well as administrators of the disciplines and institutions. What functions faculty members accomplish via computer networking, how it affects their use of traditional faculty media, and their amount of communication with colleagues, should be important to higher education researchers who attempt to describe the professoriate. In addition, administrators of disciplines and institutions should be equally interested in how computer networking affects the way in which faculty members communicate as they attempt to provide faculty members with efficient and effective media by which to accomplish their responsibilities. Finally, changes in the ways faculty members communicate, affects producers and consumers of traditional media.

In addition, the changes which such a communication technology may bring to the shared disciplinary and institutional cultures should also be of great interest to higher education researchers and administrators of disciplines and institutions. According to Pickett and Sorenson (1983) and Pfeffer (1981), consensual cultures function in part so that collective action can take place. When organizational images or master contracts differ between organizational members so too will their interpretations of events and actions as well as their behaviors (Kuh & Whitt, 1988). Therefore, if those faculty members who are currently using computer networking are beginning to view their disciplines and/or institutions in a manner significantly different from the way their noncomputer networking colleagues view them, then subcultures of the discipline and/or institution may form. Such factioning of disciplines and/or institutions both in collective philosophy and action will pose great challenges for both discipline and institutional administration. In addition, due to the close relationship between the discipline and the institution, the change of culture in either discipline or institution will impact the other (Ruscio, 1987; Clark, 1987a).

CHAPTER II. REVIEW OF THE LITERATURE

Introduction

This reviews begins with an examination of literature which attempts to define computer networking, its origins, and its applications plus the studies which have examined the effects of computer networking on interpersonal, group, and organizational communication. Next, the review highlights literature which describes faculty communication patterns and studies which have examined the effects of computer networking on faculty communication. Finally, the review presents literature which describes faculty cultures and their relationship to the higher education environment.

Computer Networking

The literature on computer networking which describes definitions, historical development and applications is reviewed first. Then studies which have examined the effects computer networking has communication are reviewed.

Definition of computer networking

Several researchers have posited definitions of computer networking. Larson (1984) generally defined computer networking as a system allowing users to send character-based messages, charts, or graphs to other communicators via the computer. Asteroff (1987) defined computer networking more specifically as "systems such as electronic mail, computer conferencing, bulletin boards, and interactive talk which permit written communication between two or more people at the same or remote sites via computer. The form of this communication is either delayed (asynchronous) or interactive (synchronous); in both cases, it is electronically text-based" (p.10).

Unfortunately, few researchers used the same terminology when referring to this new form of communication. For example, Matheson (1988) used the phrase "computer-mediated communication" while Compton (1987) used the term "computer messaging." Other labels included computer-mediated communications system, computer-aided communications, and computer-based message system (Lin, 1987). Although each of these word choices is different, each refers to the broad activity of using computers to interact with other people. For this study the term "computer networking" will be used consistently to refer to all types of human communication accomplished by networks of computers.

Although the purpose of this study is not to examine the technical features of computer networking, it is important to understand the basic functions of a generic system. (Readers interested in technical descriptions of computer networking should refer to: Black, 1987; Culnan & Markus, 1987; Green, 1986; Hirschheim, 1985; Rice and Associates, 1984; Tanenbaum, 1981.) Generally speaking, humans communicate via computers by composing a messages at a terminal or computer and then sending that message to one or many other communicators via a host computer which provides traffic controlling services. The time, date, and origin are usually attached to each sent message. The person receiving the message must either be on-line at the time or the message is stored in the their mailbox for a period of time. If on-line, the communicator can read the message immediately after it is sent. If the person is not on-line at the time of sending, they can access the stored message as soon as they log-on to the system (Compton, 1987). Some systems have the following features: notification to sender of time of message receipt, anonymous messages, and messages which automatically are deleted from the system as soon as they are read (Hiltz, 1978a, 1978b). The most common transmission technologies used to carry computer networks include twisted pair wiring, baseband and broadband coaxial cable, and fiberoptics (Black, 1987;

Gavish, 1986).

The various types of computer networks include, company networks, commercial networks, research networks and metanetworks (Quarterman & Hoskins, 1986). Many corporations like IBM, DEC, Bell Canada, Xerox and AT&T have internal computer networks which connect employees of the company who are located at geographically diverse locations. These include IBM's VNET, DEC's Easynet, Xerox's Internet, and AT&T's USENET. The corporations provide the funding and management for such systems.

Commercial networks offer computer networking services to the public for profit. Well-known commercial computer networks include TYMNET, TELENET, CompuServe, and The Source. Fees for the computer networking service are charged for connect time used.

Research networks were the first computer networks available and are usually administrated and supported by government agencies and grants. Access to such research networks as ARPANET (the Department of Defense's Advanced Research Projects Agency) , MILNET (Military Network) , MFENE (Magnetic Fusion Energy Network), and SPAN (Space Physics Analysis Network) are limited to researchers participating in govemmentally- funded research. However, CSNET (Computer Science Network) and MAILNET (EDUCOM's inter-institutional mail system), are research computer networks which provide computer networking services to researchers who are not funded by military or governmental monies. Users of these nongovernmental networks pay an annual connection fee. International research networks include: JANET (Joint Academic Network of Great Britain), EARN [European Academic Research Network, NetNorth (Canadian network), COSAC (COmmunications SAns Connections from France), DFN (Deutsche Forshungnetz from Germany), and ROSE (Research Open Systems for Europe) (Pettibone & Roddy, 1987; Quarterman &

Hoskins, 1986). One of the Soviet Union's most urgent goals is to organize a computer networking system which would connect the five enormous universities in Moscow, which coordinate and control collaborative research, with and between countries outside the USSR (Fagan, 1987).

Cooperative computer networks are networks which have developed through the common interests of their users. The commonality may be the environment and/or type of equipment. BITNET (Because it is Time Network), one of the most popular cooperative networks, originated in the academic environment on IBM equipment. BITNET is a general purpose, academic store and forward data network (Barden & Golden, 1986) which currently links 1,800 computers at 600 institutions; of the 600 schools, 100 are in Europe. In addition to this type of linkage, BITNET's gateway allows members to access other networks like ARPANET, CSNET, MAILNET, JANET, and UUCP (McCredie & Timlake, 1983; Pettibone & Roddy, 1987). BITNET users also have restricted access to VNET (IBM's internal communications network).

BITNET started in 1981 when the computing centers of the City University of New York and Yale University connected via telephone lines (Fuchs, 1983). During the early 1980s, other institutions joined the system by becoming new nodes which contributed the communications lines, intermediate storage, and computer processing needed to make its part of the network function. BITNET is also the carrier for discipline specific networks like COMSERVE (speech communication network), PHYSNET (physicists network), and COGNET (cognitive science network).

Other cooperative networks include: FidoNet (an electronic bulletin board system), ACSNET (Australian Computer Science Network), UUCP (UNIX based dial-up network), EUnet (European UNIX network), SDN (System Development Network of Korea), and JUNET (interuniversity network in Japan). Other smaller-scaled cooperative networks also exist. ScholarNET is a cooperative network which hosts PoliNET (political science, criminal justice and public administration network) and HumaNET (history, philosophy, religion, and English network) (Heisler, 1988). The National Science Foundation has connected with the Information Technology Center to build a computer network (EXPRES) through which researchers submit grant proposals (Turner; 1988a). In addition, such regional networks as: the North Carolina State Educational Computing Service, Pennsylvania Research and Economic Partnership Network, (Turner,1988b), and the New Hampshire SpecialNet Plymouth State College (Low, 1986) provide connections between regional institutions.

Metanetworks connect existing networks. The Department of Defense is currently phasing out DARPA in favor of its new Internet which is proposed to be faster and link more federal agencies to each other and other networks. Although Internet and some cooperative networks (BITNET) are able to interconnect several different computer networks, these are not considered metanetworks. Metanetworks' "constitute parts often have dissimilar protocols even as high as the transport layer" and few actually exist yet (Quarterman & Hoskins, 1986, p. 934). CSNet, a research network described above is one metanetwork currently in existence. However, many meganetwork projects are underway. The National Science Foundation is working on the NFSNET meganetwork which now connects over 280 networks and allows its users to send electronic mail messages as well as utilize supercomputer facilities remotely (Catlett, 1989). The NRI (National Research Internet) has been incubating in various government committees for several years. The National Research Council and the Office of Science and Technology proposed creating a National Research Network which would connect existing fragmented, overloaded, and poorly functioning networks and upgrade and expand existing U. S. research networks (Quarterman & Hoskins, 1986). Meanwhile Congress' Office of Technological Assessment is calling for the development of a similar National Research and Education Network (Turner,1989c). Other meganetwork plans include RARE (an attempt to unify and standardize European national networks), Pacnet (plans to link UUCP national networks in East Asia, Australia, and the United States), and AUSEAnet (a joint project between Thailand, Indonesia, Malaysia, Singapore, Bunei, and the Phillipines) (Quarterman & Hoskins).

Development of computer networking

ARPANET computer network was developed at academic research sites in the late 1960s; this system was the first major application of electronic mail and is the oldest and most extensive computer network in U.S. (Rice & Case, 1983). Another premier computer networking system was created in 1970 at the Office of Emergency Preparedness of the Executive Office of the President of the United States (Hiltz & Turoff, 1978). In 1974, The Institute for the Future provided the site and the National Science Foundation helped fund the project which included the design of the FORUM computer conferencing system and PLANET -- its commercial successor (Vallee, Lipinski, & Miller, 1974). CONFER was developed in the 1970s at the University of Michigan to aid citizen involvement in public issues. In 1979, astronomy was the first discipline to communicate via computer networking. ARN (Astronomical Resource Network) connected all the major universities in the U. S., as well as a number of observatories and research institutions. In the late 1970s and early 1980s in the academic setting, faculty members and students using computer networking in the hard sciences were joined by those in the humanities and social studies.

The number of people currently using computer networking systems continues to grow. In 1970, 250,000 data terminals were operational in the US and in 1986, there were more than three million (Chou, 1986). Electronic messages generated 70% of all first class mail in 1986. Growth rate is estimated at 20% per year. Growth in the use of computer networks is due to the lower cost of microcomputers and the access to networks and timesharing systems. In addition, the simplicity of the computer networking systems has allowed many persons who do not have technical expertise to use the systems effortlessly. Other reasons for growth include: the development of operations research management sciences and cost analysis, the emergence of the information-based society, and the creation of computer-assisted instruction (Hiltz & Turoff, 1978; Asteroff; 1987).

Usesof computer networking

Matheson (1988) believed that the sophistication and proliferation of computer networks would yield their use in complex communication tasks and environments, e.g., group decision-making, organizational management and problem-solving, long-distance collaborative work, and social support networks. Most computer networking systems offer electronic mail, electronic bulletin boards, integrated office support systems, and computer conferencing (Hiltz & Kerr, 1986; Beckwith, 1987). Electronic mail allows private users to transmit private messages. Bulletin board systems permit public users to disseminate and discuss information and ideas. Bulletin boards are functionally different from electronic mail in that messages are sent to a large group of people whom the sender may or may not know -- much like the use of a traditional cork bulletin board (Asteroff, 1983). Integrated office support systems provide group text processing and decison support (Lin, 1987).

Computer conferencing is a public or private electronic forum. Computer conferencing systems can be delayed or interactive. Computer-conferencing allows group-to-group communication to happen without the need to travel to a common geographic area. Computer conferences usually are organized by a moderator and possess electronic mail and bulletin board features as well as many unique abilities. For example, computer conferences support several levels of public and private, delayed and interactive messaging between users as well as interrelated subconferences, text editing, and file transfer. In some cases computer conferencing can facilitate questionnaire polling and voting with guaranteed anonymity (Asteroff, 1983). According to Hiltz and Turoff (1978), computer conferencing is the least expensive, most convenient, and most powerful type of communication for dispersed people who must regularly communicate information and opinions. (For readers interested in a description of the specific advantages of computer conferencing, see Cross & Raizman, 1986, pp. 133-134.)

Research on the effects of computer networking on the communication process

Much research has been conducted on the social effects of computer networking. For general literature reviews of the social impacts of computer networking see: Bair (1979), Featheringham (1977), Hiltz (1984), Hiltz and Kerr (1981), Hiltz and Turoff (1978), Johansen (1977), Johansen, Vallee, and Spangler (1979), Kerr and Hiltz (1982), Kling (1980), Moss (1981), Nilles (1975), Rice (1980a, 1980b, 1982a), Rice and Case (1981, 1983), Tombaugh (1984), Uhlig (1977), and Uhlig, Farber, and Bair (1979). Major topics of the social effects of computer networking in these reviews include: acceptance of systems, uses of systems, patterns of use of systems, and attitudes toward systems.

However, since the focus of this study deals specifically with computer networking and faculty communication and culture, this review describes only that literature which examined how computer networking affects the process of human communication. An introduction describes the state of current research on the effects of computer networking on the communication process. This is followed by a brief overview of the literature which described computer networking effects on interpersonal, group, and organizational communication.

Introduction to computer networking effects on the communication process The impacts of computer networking is an important concern to communication researchers (Rice,1982b). In The Medium is the Message Marshall McLuhan contended the medium affects both the transmission and interpretation of the message. Communication theories must take into account how the medium of computer networking affects communication by examining how computer networking characteristics influence the communication process (Compton, 1987).

Some researchers argued for the development of new communication theories which encompass the issues computer networking raises. Vallee, Johansen, Randolf, and Hastings (1974) and Kochen (1978) pointed out the ineffective yet popular practice of comparing computer networking interactions to face-to-face interactions as if the latter mode is the standard by which to evaluate all communication media. Instead, they argued that each medium should be investigated in order to discover its own unique and inherent attributes (Hiltz & Turoff, 1978). Cathcart and Gumpert (1986) introduced the idea of "mediated interpersonal communication" to describe communication settings where technological media transcend the limits of time and space of a face-to-face interaction. In essence, computer networking is different from face-to-face communication because it requires writing skills and produces a permanent record.

Researchers who have published reviews of literature and metaanalyses on research which has focused upon the effects of computer networking upon the communication process agreed that this body of research is scattered and lacks cohesiveness (Kerr & Hiltz, 1982; Rice, 1989). Research in this area has been riddle with diversity from the variety of disciplines working in the field, the variety of computer network system designs, the variety of subject characteristics and environments, and the variety of methodologies used to analyze the phenomenon (Kerr & Hiltz, 1982; Rice). Such research started a decade after the development of the first computer network system and continues vigorously today. And although much research has been accomplished on this topic, scholars argued that the field is still in its infancy. The youthful nature of this research area appears in the lack of focus of subject examination (Asteroff, 1987; Bavelas, 1963; Compton, 1987, Hiemstra, 1986; Hiltz & Turoff, 1978). Kerr and Hiltz also stated that although the literature on computer networking is "fairly extensive" some is out of print or not published. Those studies which are published tend to be "either application-oriented or conjectural discussions of potential impacts upon subgroups" (p. 94).

The methodology used in research on the effects computer networking has on the communication process has included multiple research designs (controlled experiments, field trials, laboratory tests, and practical applications) and methodologies (quantitative and qualitative content analysis, discourse analysis, network analysis, ethnography, and instructional evaluation) (Asteroff, 1987).

Two computer networking systems which have generated the data for many of the studies referred to later in this review, deserve a brief description. The first of these is the PLANET system. In 1974, the FORUM computer conferencing system was funded by the National Science Foundation and designed at The Institute for the Future (Vallee et al. 1974). Later, when the system commercialized, it became known as "PLANET". FORUM linked 500 members of more than 18 organizations over a two-year period. These organizations included government agencies, independent research groups and business organizations. Over 77% of the all usage came from researchers from the U. S. Geological Survey, Institute for the Future, Charles F. Kettering Foundation, National Aeronautics and Space Administration, and the Energy Research and Development Administration. Various researchers used the interaction from these groups linked by computer networks to study the the long term effects of computer networking on the research process. Researchers used on-line monitored statistics, a series of self report surveys followed by unstructured interviews, and some participant observation to study the groups.

In the early '70s, the EIES (Electronic Information Exchange System) was also developed in order to discover more about the uses and effects of computer networking. The National Science Foundation awarded Murray Turoff monies to design this computer networking system at the New Jersey Institute of Technology with the basic purpose to improve communication among geographically dispersed researchers. In designing EIES, Turoff began by considering the informal and formal characteristics of specialized scientific communication as described by Chubin (1975), Crane (1972), Garvey and Griffith (1967) Hagstrom (1976), and Price (1963). The EIES featured message-sending, computer conferencing, and creation and sharing of personal notebooks. Turoff believed that these EIES message-sending features could replace letters, telephone exchange, and face-to-face conversations. Computer conferences could replace face-to-face meetings. Computer notebooks (private on-line space for drafting which can be opened for others to see) would replace draft and preprint exchange and the necessity for co-authors to be in the same geographical location. Electronic bulletin boards could replace newsletters and eventually eliminate journals and abstract services. In addition, the development of electronic data bases which could be searched and data retrieved on-line could be built and accessed more quickly than waiting for the publication of research results.

Scientific groups wanting to use this system applied and competed for the grant award. A total of 700 participants in ten groups made up the EIES for the first 25 months of its life. The scientific communities which used the system included groups of scientists interested in futures research, social networks research, systems theory research, complex man-machines systems research, and devices for the disabled research. Group members were university researchers and teachers and personnel from government-sponsored agencies (Hiltz & Turoff, 1978).

All Interactions between users of EIES were continuously collected by the computer, aggregated into monthly intervals, identified by sender, receiver, and date, and analyzed by a statistical package which was built into the system. Data on the various dependent variables were collected via mailed questionnaires, participant observation, an on-line survey, memos, and EIES' help function (Hiltz & Turoff, 1978).

Computer networking effects on interpersonal communication Research on the effects of computer networking on interpersonal communication focused upon such topics as: nonverbal cues, attitudes, time, social emotional content, social presence, and relationship building.

Communicating via computers requires communicators to depend on written symbols and thus contend with the absence of nonverbal symbols (Fulk & Van Tassel, 1985; Hiltz & Turoff, 1978). This loss of nonverbal symbols includes appearance, body movements, body posture, facial expressions, eye contact, and paralinguistics. Therefore, the bandwidth or the amount of information that can pass through a given channel is more narrow for computer networking than for other nonwritten forms of interaction. Many researchers agreed that computer networkers quickly learn to create and substitute written symbols for the absence of nonverbal symbols (Asteroff, 1987; Carey, 1980; Hiltz & Turoff, 1978; Kiesler et al., 1984; Pollack, 1982; Sherblom, 1988; Spitzer,1986). Carey was the first to systematically investigate the unique paralinguistic features of computer networking. He studied Vallee and Johansen's PLANET and Hiltz and Turoff's EIES systems. Carey labelled five different attributes of written paralinguistics and articulated the contingencies of interpretation and patterning of computer conferencing paralinguistics.

The attitude of the computer networkers toward the computer and the attitude toward computer communication was the focus of some research. Rauchenberg (1984) and White et al. (1986) looked at how the computer networkers' attitude toward computers, in general, may affect their computer network communication. Compton (1987), Gengle (1984), Hansen (1985), Rogers (1986), Ugbah (1986), Vallee et al. (1974), and Vallee et al. (1975) investigated how users may perceive the computer affecting confidentiality and personalization of their messages.

Computers also affect the time component of the communication process. Computer networking provides an alternative to the traditional notion of time, for computer networking exchanges can be synchronous or asynchronous. The unique asynchronous feature of computer networks allows interactants to communicate with each other without intruding on each others' space or time (Compton, 1987; Hiltz & Turoff, 1978; Kiesler et al., 1984; Vallee et al., 1975; Welsch, 1982).

Because computer networking communication occurs between interactants physically separated and through a computer, many researchers have investigated the effects on the social-emotional content of interpersonal messages. Some researchers blamed the narrow bandwidth of computer networking for an increase in the seriousness, depersonalized, businesslike, and task oriented nature of interaction and a decrease in emotional and friendly elements (Furgeson, 1977; Hiemstra, 1982; Hiltz & Turoff, 1978; Johansen & DeGrasse, 1979; Krueger & Chapanis, 1980; Lin, 1987; Rogers, 1986; Spelt, 1977; Vallee & Johansen, 1974; Vallee, Johansen, Lipinski, Spangler, Wilson, & Hardy,1975; Vallee et al., 1978). Rogers found that 30% of interactions made via an electronic bulletin board dealt with socio-emotional content. In an other study, Rice and Love (1987) found that between group interactions were more likely to contain socio-emotional content than within group communication in a computer networking. They used NEGOPY (a computer program for network analysis) to identify the network links. Rice and Love, using Bales categories, found, via content and network analyses, that more active computer networkers send messages with more socio-emotional content.

The social-emotional content of interpersonal messages is sometimes related to social presence. A research group from the University College of London (Communications Studies Group) was the first to coin the phrase "social presence". Social presence is "the degree of salience of the other person in the interaction and the consequent salience of the interpersonal relationship" (Short, Williams & Christie, 1976, p. 65). Due to the geographic differences between communicators, computer network communication has less "social presence" (Short et al., 1976; Vallee et al.,1974). Due to a lower level of social presence, computer networking reduces the communicator's consciousness of the social context of communication or in other words their "other-directedness" due to the media's inability to communicate cues of others and the context (Kiesler et al., 1984; Kiesler, Zubrow, Moses, & Geller, 1985; Matheson, 1988; Orcutt & Anderson, 1977; Short et al., 1976). Hiltz (1978b) found computer networkers have tend to display overt social activities and an open public image. Computer networkers are more explicit and exhibited more informal sociability than face-to-face communicators (Hiltz & Turoff, 1978). Computer network users are less inhibited -- as measured by insults, name calling, and hostile comments and verbal flaming (Hiltz, Turoff, & Johnson, 1985; Kiesler, Siegel & McGuire, 1984; Siegel et al., 1986).

Related to the issue of socio-emotional content of messages and social presence is the relationship building that such messages promote or fail to promote. Researchers argued on both sides of the question dealing with the effect of computer networking on relationship building. Due to the lack of morale which is built via face-to-face communication and non-verbal symbols, many scholars found that computer networking has negative effects on interpersonal relationships (Giffin & Patton, 1976; Hiltz, 1978a; Johansen & DeGrasse, 1979; Kotter, 1982; Krueger & Chapanis, 1980; Mintzberg, 1973; Orcutt & Anderson, 1974, 1977; Rice & Case, 1983). Contrastingly, other researchers found that computer networking facilitates a social dimension where communicators express emotions and build interpersonal relationships without face-to-face communication (Compton, 1987; Gengle, 1984; Hiltz & Turoff, 1985; Johansen & DeGrasse, 1979; Marvin, 1983; Phillips, 1983; Rafaeli, 1983; Spelt, 1977). Phillips found that computer networking brings people together more - there are more serendipitous group interactions.

Computer networking effects on group communication Many researchers investigated how computer networking affects small group decision making (Rice, 1984) and overall agreed that computer networking enhances group decision-making. One of the many topics in this area of research has been equality of participation. Most researchers agreed that computer networking groups have more equal participation than face-to-face groups (Hiltz, 1978b; Hiltz & Turoff, 1978; Kiesler et al., 1984; Siegel et al., 1986, Vallee et al ., 1974, Vallee et al ., 1975, Vallee & Johansen, 1974).

Not only does computer networking have an effect on level of participation but also on the type of participation. Some researchers found that computer networking groups used more specific language (Compton, 1987; Furgeson , 1977; Hiltz & Turoff, 1978; Phillips, 1983). Other studies reported that computer networking group members asked for more opinions, made more suggestions, and showed less tension release than face-to-face groups (Hiltz & Turoff; Hiltz, Johnson, & Agle, 1978). From these types of interactions, computer networking groups produced better arguments and decisions. Computer networkers produced better arguments due to their opportunity to see and revise a message before sending it and access to nonlettered visual cues such as drawings, enumeration, and indentation (Hiltz & Turoff). In addition, computer networkers having difficulties in coming to a unanimous decision on a complex problem because equal participation and less overt agreeing and disagreeing behaviors (Hiltz, 1978b, Hiltz & Turoff 1978, Kiesler et al., 1984; Siegel et al., 1986). Kiesler et al. found computer networking groups have less groupthink and use less persuasive tactics when the discussion is held via computer networking.

Not only has much research been conducted on the effects of computer networking upon the group communication process, but a growing group of group communication researchers use computer networking as a methodology (Rice & Barnett, 1985). Such researchers use a computer networking system to capture transcripts of actual interaction between all group members over a long period of time. After these valuable data are collected, researchers use computerized network or text analysis to study the data. Danowski (1988) has been active in using computer networking as a method for capturing interaction between organizational members so that it may be analyzed on such variables as communication networks and message content.

Computer networking effects on organizational communication Not only has much research been conducted on the effects computer networking has on interpersonal and group communication contexts, but many researchers have worked to understand how computer networking may affect the various principles of organizational communication. Many computer networking studies looked at the effects computer networking has on accomplishment of organizational communication tasks and on the physical nature of the communication channels (Chapanis, 1976; Compton, 1987; Danowski, 1982a; Francas & Larimer,1984; Gengle, 1984; Hiemstra, 1986;Kiesler et al., 1984; Phillips, 1983; Porter et al., 1986; Rice, 1982b; Rogers, 1986; Short et al., 1976; Vallee, Johansen, Lipinski, Spangler, & Wilson, 1978). One of the most popular areas of study looked how computer networking increases the organizational goal of productivity (Bair, 1979; Johansen, Vallee, & Palmer, 1976; Quibble & Hammer, 1984; Rice & Bair, 1984; Spelt,1977; Tapscott, 1982). Other scholars argued that computer networking affects various factors of organizational structure or status (Compton; Danowski, 1982a; Gengle; Hiemstra; Katzman, 1974; Kieffer, 1985; Kiesler, 1986;

Melody & Mansell, 1983; Naisbitt, 1982; Rice & Case, 1983; Rice & Williams, 1984; Rogers; Ugbah, 1986; Welsch, 1982).

Faculty Communication

> Communication is the essence of scholarship. Wherever the scholar may pursue his or her addiction to scholarship, whatever might be his or her field or discipline, the ability to exchange and debate ideas with fellow scholars, including students, or with the public generally is a *sine qua non* of the scholarly life (Langenberg, 1989, p. 12).

Cole and Cole (1973) argued that "Scientific advance is dependent on the efficient communication of ideas. The communications system then is the nervous system of science; the system that receives and transmits stimuli to its various parts" (p. 16). Clark (1980) posited that another purpose of interaction between members of the same discipline at remote sites is to affirm membership in that discipline. Communication between faculty members is used to communicate membership requirements, reaffirm virtues of the field, report on the conditions of the field, award outstanding members, and describe a code of ethics. From such interaction, members build very strong identities in the discipline and share beliefs and norms about theory, methodology, techniques, and problems (Clark, 1983; Gumport, 1987). After studying 1,300 scientists from governmental, industrial, and academic laboratories, Pelz and Andrews (1976) concluded that researchers who communicated with each other often showed higher levels of performance due to the role interaction plays in ideation, information, instruction, cooperation, evaluation, competition, alertness, and relaxation. This valuable faculty communication takes place at several levels such as private discussions with close colleagues, small seminars within departments, and papers at conferences (Raymond, 1989).

Faculty members communicate with a wide variety of people in a fairly wide variety of contexts. Since the scope of this research is faculty communication with other faculty members, this review is limited to literature describing this aspect of faculty communication. Likewise, since this study is limited to faculty members from top research universities, this review highlights reports concerning the communication process of faculty members engaged primarily in research responsibilities. This review begins by distinguishing between informal and formal faculty communication and then focuses upon literature which describes the traditional faculty communication process, variables which affect the process, and studies which have investigated the effect of computer networking upon faculty communication.

Informal and formal faculty communication

It is difficult to describe the difference between informal and formal communication from a chronological perspective for both types of communication are used at various times throughout the faculty communication process. Instead, the relationship between the formal and informal channels can be compared to mass communication's two-step model whereby the media transmits a message, and then opinion leaders via interpersonal communication help receivers selectively attend to various messages. Such is true with the formal and informal networks of scientists. The journals provide a wealth of information and invisible college members highlight the importance of some of the issues. The more active the researcher, the more informal contacts will be made to monitor various situations (De Mey, 1982). Informal communication systems complement the formal structures and help to produce the large amounts of literature describing an innovative theory or method very quickly (Griffith & Mullins, 1972; Mullins, 1973).

The informal communication networks between faculty members engaged primarily in research are usually referred to as "invisible colleges" (Crane, 1972; Hagstrom, 1976;

Price, 1963). The term "invisible college" was first used by Boyle in 1646 to describe what later on became the Royal Society; Price, in 1963, resurrected the term to mean a group of researchers working in a common research area yet located in different organizations (research institutes, universities, and/or disciplines) (De Mey,1982). Today, the term denotes the informal connection of scientists who are mutually interested in a research area (Clark, 1987a). Chubin (1975) explained that while the broader notion of disciplines define the direction of teaching, these invisible colleges which are "nestled within and between disciplines" (p. 1) influence the research agenda. These invisible colleges are unique for not only do they serve to direct and redirect the task of articulating important research ideas and designing new methodologies, but they are also responsible for building the culture of the group by reinforcing norms and allocating rewards (Becher, 1987; Clark, 1980; Crane, 1972; Griffith & Mullins, 1972; Price, 1963). Clark (1987a) stated "In all the disciplines, from the humanities to the sciences, the invisible associations have a primary role in self-identity, communication, and the bonding of members of the profession" (p. 249). Hagstrom argued that invisible colleges are ubiquitous and "perhaps, the most important level of the social organization of science" (p. 758). Most invisible colleges exhibit effective but loose communication networking. This loose network is created by researchers who attempt to solve a research problem and fail to find an adequate formal communication system with which to do so (Griffith & Miller, 1970).

Traditional faculty communication process

The first step in the traditional faculty communication process is idea generation. Garvey and Griffith (1971) found that faculty members rely most upon informal networks to keep them abreast of current activities and views of their discipline, thereby stimulating research ideas and programs. According to a study of 200 research efforts in psychology, Garvey and Griffith found that less that one out of seven research ideas emerged from reading journal articles or hearing presentations given at national conferences. Instead, faculty members usually rely on their invisible colleges to aid them in idea generation.

Dependent on the size and prestige of the local department, a faculty member's Invisible college will be comprised of either local or remote colleagues. According to Hagstrom (1970), faculty members of highly prestigious departments will have more local colleagues in their invisible colleges than faculty members of less prestigious departments. In addition, through communicating with local colleagues who may or may not be a member of their invisible college, many faculty members help link each other with other researchers from other universities, thereby increasing each others' overall connectivity and informal networks. Schorr-Morelock (1972) found that amount of communication between and within university departments depends on the educational level, the age and the gender of the departmental members. She found that older males with a high educational level communicate most frequently.

Regardless of the local or remote nature of the invisible college members, such informal interaction eventually gives birth to a research project. Research projects are either accomplished alone or in teams. (See Becher (1987) and Hagstrom (1970) for more information on the multi-authoring of a research project.)

After faculty members have an idea of the area of research, and have made the decision to work alone or in teams, they interact with members of their invisible college in order to formulate the research problem more specifically and obtain information and opinion on methodological, apparatus, and/or data analysis issues. In addition to the information and opinions, faculty members sense their peers' interest level on the topic and thus are stimulated to process forward with the project or drop it. With the exception of casual but fruitful discussions with immediate colleagues, faculty members spend the next 12-18 months working on their research and remaining relatively uncommunicative (Garvey & Griffith, 1971).

When the faculty members believe their work is significant enough to share it with others, they begin to informally share it with a few selected and trusted colleagues. Garvey, Lin, and Nelson (1970) found that 83% of physical science journal authors informally disseminated their work at least once before publication in a journal. They may begin by presenting to a small colloquia within the institution. Or if faculty members are recognized as top researchers in their field, they may accept an invitation to share their recent work with a small conference of specialists working in the same topic area. Because faculty members are sharing their work with others who share fields of experience, brief communication suffices.

Within a few months of this initial communication of research results, faculty members report their work to a meeting of a state, regional, or national professional society (Garvey & Griffith, 1971). Since many disciplines are dividing into sub-specialties in order to communicate better with their wide range of specialized members, many faculty members have refused to go the annual conferences of the discipline's association; instead, they opt to go to the smaller meetings which are organized either around a type of institution, or specialized topic or both (Clark, 1987b).

Since published programs are sent to society members prior to the meeting, some researchers may be asked to send copies of their presentation to others who may or may not be able to attend the meeting. Those who make this early request are usually young researchers who are not yet members of an invisible college where the author first revealed his or her work.

Informal interaction with colleagues at conferences provides valuable feedback for presenting faculty members. Three-fourths of those who present papers at national conferences seek journal publication following the conference (Garvey & Griffith, 1971).

Therefore, the interaction with their peers at the gathering affords faculty members necessary critical feedback prior to submitting the manuscript to the journal editorial process. One in six meeting-presentation attendees will interact with researchers about the presentation; approximately one-half of these will do so while at the meeting but not while in the presentation session (Garvey & Griffith). This communication usually focuses upon questions the presentation attendee has regarding some aspect of the research not mentioned in the presentation. Garvey and Gottfredson (1979) found that 50% of journal authors who orally presented their work revised their work based on the feedback they received at the oral presentation before submitting to journals. Some researchers may also be working on an offspring research project to that reported at the conference and collect information for their embryonic work from conference interactions (Garvey & Griffith).

This presentation interaction is valuable to researchers not only for feedback purposes, but also for building contacts. Conferences serve as an initial stepping stone for young researchers attempting to enter into informal networks in their interest area (Garvey et al. 1970). It seems that both the presenters and attendees use conference interaction to become acquainted with each other so as to set up a mechanism whereby they may use each other as sources in future research. Therefore, not only are young researchers indirectly asked to join invisible colleges already in place, but also new invisible colleges are incubated by conference communication.

According to Garvey and Griffith (1971), one-tenth of faculty members at this point in the research process will produce a technical report. The purpose of most technical reports is informal speculation instead of formal confirmation.

Another popular informal communication medium for faculty members is the preprint. Preprints are distributed at several occasions relative to submission and acceptance of journal articles (Hagstrom, 1970). "Prior to manuscript submission, the authors primarily seek comment and criticism; after submission or notification of journal acceptance, authors distribute preprints as a means of rapidly and selectively disseminating their findings to other workers in the subject-matter areas" (Garvey & Griffith, 1971, p. 357). Over 60% of faculty members who submit preprints modify their manuscripts based upon the feedback received from the preprint.

A recent controversy over the importance of preprints surfaced during the nuclear fusion discovery at the University of Utah. Officials at the University of Utah leaked news of the discovery of fusion to the greater public via the press on March 23, 1989. Such an act openly severed the implicit rules of faculty communication which encourage faculty to use preprints to keep peers abreast of research developments so that confirmations of the study and refutations can occur. According to James Brophy, the vice-president for research at the University of Utah, officials refused to release preprints on the fusion development because the preprints would undercut a journal publication. However, Robert Park, head of the American Physics Society, stated that such an excuse was unacceptable for "Everybody exchanges preprints. We have preprint libraries. The information comes in faster than publications can keep up with" (McDonald, 1989).

After having used the informal system of presentation, feedback, and modification, faculty members are then ready to submit their manuscripts to the more formal journal editorial process. Journals are refereed by peers of the the discipline. An average lag-time of nine months exists between manuscript submission and journal publication (Garvey & Griffith). Rejection rates vary by discipline and journal. The most frequent reason given for rejection is "inappropriateness of subject material" for particular journals. However, this may be a socially acceptable way of responding to a poor quality manuscript. Many faculty members understand and utilize the hierarchical systems of journals in that when their manuscript is rejected from a journal of high status, they continue to submit it to journals of lower status until it is accepted. During the two months following article publication, the audience is very small. Garvey and Griffith (1971) found that from 1-7% of all psychologists read journal articles; this number is similar to the size of informal (meeting programs, technical reports, reprints) audiences who are more likely to read the material.

Within the past decade, the refereed journal step of the traditional faculty communication process has suffered much criticism. Lewenstein (Raymond, 1989) argued that the role of peer-reviewed journals is given too much weight in the academic communication context. "Science does not not exist until it is published" (p. A8). Because of such a a long lag time and such a small audience, Garvey and Griffith (1971) argued that the actual function of journal publication has changed from its original goal of collaboration with researchers in specialty areas. Instead, journal publication is now used to inform researchers in other specialties and allocate recognition and reward. According to De Mey (1982), journal publications are not so much communication conduits as they are "cadastral registrations for intellectual property" (p. 132). The real purpose of a published article is to claim possession of a sector of the knowledge domain (De Mey). De Mey based this argument upon studies (Swanson, 1966) which showed that very little of all published academic literature is read. The main reason for the low level of readership is due to researchers accessibility to research activities and findings via informal networks. In addition, journal publication costs are soaring and faculty members are now going outside of the peer review system in order to gain competitive financial support thereby weakening the peer-review journal system (Raymond, 1989).

About seven to eight months after publication, the article is usually abstracted in the discipline abstracts. Two to three years after publication, other researchers may begin citing the article and it is evaluated in light of other information which has been generated since its publication. During this same time period, the publication may be featured in reviews or metaanalyses conducted on the subject area. A decade or more after publication, the article may be referenced in specialized texts.

One method of measuring faculty communication is based upon this final step of the communication process whereby researchers' articles begin to be cited in other researchers' articles. Sociologists of science use this methodology of studying communication patterns of researchers by citation analysis (Gumport, 1987; Meadows, 1974). De Mey (1982) reported that researchers interested in the sociology of science may use citation analysis techniques such as bibliographic coupling or co-citation clustering to study interactions between scientists. Citation analysis assumes that the resources cited in the bibliography of a paper can lead to a sociometric profile of its author. More specifically, bibliographic coupling attempts to discover the affinity between papers and thus between authors by measuring the papers common references. Similarly, co-citation methodology , discovered by Small (1973) and Marshakova (1981), focuses upon the frequency with which cited items are cited together in order to piece together the relationship between authors.

Variables in faculty communication

Although most all faculty share the common elements of the traditional communication process such as idea generation, pre-conferences presentations, conference presentation, technical reports and preprints, and journal publication, some variance in the communication process occurs due to such variables as the faculty members' discipline affiliation, institutional and departmental affiliation, and experience.

Discipline variance Although no significant research has been conducted on specific disciplines, many studies have compared communication patterns of various groupings of similar discipline types. Most studies looked at differences between the humanities, physical sciences, social sciences, and engineering sciences (Garvey et al., 1970; Price,1970).

Price (1970) argued that hard sciences grow faster than the humanities and described how communication rates are affected by this growth. According to Price, the humanistic scholar,

> has to digest all that has gone before, let it mature gently in the cellar of wisdom, and then distill forth new words of wisdom about the same sorts of questions. In the hard sciences the positiveness of the knowledge and its short term permanence enables one to move through the packed down past while a student and then to emerge at the research front where interaction with one's peers is as important as the storehouse of conventional wisdom (p. 15).

In this quote, Price addresses the relationship between discipline paradigmatic development and communication necessity. In disciplines where there is great agreement on the definition of research concepts, problems, and methodologies, less communication is needed in "explicating definitions, developing theoretical arguments, and defining and justifying variables and their measurement" (Pfeffer, 1981, p. 17). Beyer's (1978) and Pfeffer, Salancik, and Moore's (1979) empirical studies, which both supported this theory, found that the more paradigmatically developed physical sciences generated shorter journal articles and dissertations.

Related to the paradigmatic development issue, Mullins (1973) argued that scientific communication varied according to the phase of paradigmatic development of specialty groups within disciplines. In the first phase of specialty group development, scientists who are experiencing a change in perception of the topic they are analyzing begin to communicate about their ideas with a very wide group of researchers usually from other disciplines and other departments. At this point there is little coordinated research activity and little or no co-authorship. Then as one of these scattered research efforts launches into success, those with similar interests become acquainted with each other through critique and/or praise of the successful product. In the network stage, this acquaintance network begins to bloom into a thicker scientific communication network with more frequent interactions between fewer scientists. Next this group enters into the cluster stage where communication becomes even more ingrown as scientists begin to take on student apprentices, more co-authorship occurs, and a statement of consensual problems to attack is published. Finally, the group could enter the final specialty phase where students are hired away to other institutions. To keep communication ties, new journals and departments are institutionalized or old journals and departments are taken over and changed to this new direction. In this last stage communication may increase for a while, but it gradually is dispersed between many weaker linked scientists. This final stage sets the scene for returning to the normal or first phase of the cycle.

Researchers from different disciplines also differ in the organizational tightness of their communication process. Physical science research communication is quite tightly structured and sequenced. First, physical science researchers experience the shortest lag time from inception of the project to publication. Part of this is due to the shorter amount of time physical scientists spend preparing their manuscripts before submitting them for journal publication. Another factor is the short lag time between submission and publication. Physical science researchers also face a lower publication rejection rate than their counterparts in other discipline types; therefore, the lag time of publication and publication quantity is lower (Fulton & Trow,1974) . According to Garvey et al.'s (1970) study, the physical sciences published two and one-half times as many presentation-based manuscripts using the same number of journals within the same period of time. Also, a larger percentage of physical scientists make prepublication reports and make them more frequently and to a wider variety of audiences within a shorter period of time. De Mey (1982) found that hard science journal articles cite more recent references, are shorter, use fewer references, and cite references from a smaller pool of specialized journals than humanities journal articles.

Physical science researchers make more oral prepublication reports than other discipline groups but use technical reports and preprints as their most common prepublication written genre rather than theses or dissertations. Preprints are generally personally distributed to colleagues working in the same area as well as those who become aware of the research through earlier prepublication dissemination; few hard science researchers use formally organized preprint exchange. This strong informal prepublication network explains the reason more physical scientists are acquainted with the main content of article before they are published (Garvey et al., 1970). Physical scientists are less likely to request interaction with colleagues at and after conferences than the other types of disciplines.

Becher (1987) believed that the differing interaction patterns of various disciplines is based upon whether research is conducted on very closely related topics by small teams or not. Generally, physical scientists work more frequently in teams than the other discipline types. Where decentralized teamwork is the heart of research activities, communication must be swift and frequent, whether meeting in conferences, telephone conversations, or quick publication turnaround times. Becher found that many generalists all working in on a closely related problem tend to communicate more than a few narrowly focused individuals; in addition, the large group of researchers working on the same problem breeds competition for the first to publish results and claim ownership of research area.

The faculty communication process is also contingent upon the amount of independence technologies provide various disciplines. Hagstrom (1976) gave the example of autonomous chemistry professors who work very independently due to workers and apparatus which is under their exclusive control. Hence, Hagstrom found the more independent academic work groups are, the lower the degree of collaboration among faculty peers: 44% among chemists, 68% among experimental physicists, and 61% among biologists.

Institutional variance The literature in this area was both scant and scattered. In essence, faculty members from prestigious institutions, which have strong norms of publication expectations are more likely to publish (Fulton & Trow, 1974; Long, 1978). This corresponds the "Mathew effect" where new faculty members who receive early recognition for their research will most likely receive greater resources with which they can produce even more recognition. Also, Becher (1984) found that faculty members in smaller departments were more likely to cross institutional boundaries in order to find colleagues with similar specialties with whom to collaborate.

Experience variance Here again few studies have been conducted regarding the effect experience has on the faculty communication process. However, the available literature shows that more experienced faculty members tend to read journals less (Meadows, 1974). It seems older scientists use journals less due to little available reading time and ease at obtaining information via informal channels.

Previous research on computer networking effects on faculty communication

As mentioned above, much research has been conducted on the general social or communication effects of computer networking; however, a much smaller group of studies have examined the effects of computer networking within this unique higher education setting. Some studies are based on empirical studies while most are quite speculative. This literature can be categorized by its emphasis on either the applications or the effects of computer networking.

Uses of computer networking in higher education In the early 1980s, many researchers from the social/psychology perspective of computer networking research found the university setting ripe for study (Asteroff, 1987). Hiltz and Turoff (1978), provided an overview of the general applicability of computer networking to the higher education environment. First, because of retrenchment in the universities, more recent Ph. D.s are locating at isolated liberal arts colleges where they have few, if any, colleagues interested in their highly specialized research area and where rewards are given for teaching, not research. Second, tenured faculty members find themselves more immobile because of the retrenchment environments and thus research ideas too become immobilized. Third, travel and communication budgets are being cut on many campuses due to the weaker economic situation. Fourth, although more federal monies are being spent on interdisciplinary studies, researchers lack a communication means to interact with researchers in other disciplines. Fifth, the information overload, evidenced by the tremendous growth in academic publications, forces researchers to either spend more time in literature reviews and less time on original projects or continually tighten the focus of already specialized research areas. Sixth, the increasing specialization of researchers many times forces them to do joint authorship with others who probably do not share the same geographical location. Seventh, presently, the turn-around time from completed research to publication is much too long. Eighth, many faculty members in developing countries are forced to leave the region due to inadequate communication systems.

More specific literature focused on the uses of computer networking in the teaching, administrative and research areas of higher education.

Uses of computer networking in teaching activities Computer networking is most useful in distance classroom settings. Computer networking complements telephone and mail in distance classroom settings (Hiltz, 1986; Kaye, 1987a, 1987b; Mason, 1987;

McDonnell & Raymond, 1987; Moore, 1987). Computer networking also allows for possibly more effective student-teacher interaction than that which occurs in a traditional classroom because of its status-free and time convenient nature (Feenberg, 1986; Hiltz, 1985; Karabenick, 1987; McCreary & Duren, 1987; Quinn, Mehan, Levin, & Black, 1983; Welsch, 1982). Computer networking permits interactive classroom visits from distant lecturers. Vallee et al. (1975) reported that graduate students in astronomy programs are required to carry on idea and problem-solving discussions with active field researchers via computer networking. On-line discussions and analyses of breaking crisis situations involving specialists from all over the world can be conducted by computer networking (Slatta, 1987). Finally, at Princeton, juniors and seniors submit drafts of their theses to be examined and commented upon by their advisers via computer networking. Such advising is also available and an advantage to Ph.D. candidates who are writing their dissertations at an off-campus site while retaining a fulltime job or while their major advisor is on sabbatical or a leave (Bogucki, 1987).

Uses of computer networking in administration activities Computer networking is also being used to coordinate educational programs in institutions with campuses in dispersed geographical areas (Davies & Jullian, 1985; Spitzer, 1986). Kimmel, Kerr and O'Shea (1987) described the use of EIES: to disseminate information on new curriculum materials, to interact with curriculum directors, to collect data from teacher tests of curricular materials in the classroom, to plan tailored training sessions with teachers, to initiate post-workshop interaction to sustain motivation, to connect teachers with resource people, and to provide formative evaluations of new materials. Rice and Case (1983) found that computer networkers (in this case senior university executives and computer center staff using Stanford University's Terminal for Managers) believe that electronic mail is most appropriate for exchanging information and asking questions and least effective for managing conflict, building relationships and negotiating. Those more experienced with the system (computer center staff) saw the system as less impersonal and rated it more appropriate medium than the inexperienced users.

Uses of computer networking in research activities Research is the area of higher education which uses computer networking the most; researchers most value the speed of communication and accessibility to resources offered by this new technology. Faculty members use computer networking to: interact asynchronously, find peers interested in a specific topic, reduce access time to information, peruse pre-prints via a data base search, solicit multiple reactions to new hypotheses or datum within a short period of time, participate in joint research efforts with colleagues in remote areas, prepare research proposals, set up meetings or conferences, and access shared resources (Barden & Golden, 1986; Fuchs, 1983; Greenberger et al., 1974; Hiltz & Turoff, 1978; King, 1988; McCredie & Timlake, 1983; Pettibone & Roddy, 1987; Pierce & Cooley, 1985; Slatta, 1987). Manuscripts written in two separate locations can be merged and edited into a final product without retyping. Revision and modification of manuscripts is quick and efficient (Bogucki, 1987). On-line polls can be set up, administered, and tabulated immediately via computer networking (Slatta). Turner (1988a) reported that EXPRESS software developed from a NSF grant allows researchers with dissimilar hardware and software environments to send not only a document or a graph over the system but also the logic used to create it. Faculty members who move from one institution to another use computer networking to send their files to their new institutional account inexpensively and with a great degree of security (Bogucki).

Some scholars have predicted that computer networking may also be used to shorten the publication process (May, 1985). "In an electronic network, the processes of authorship, of editorial review and the refinement, of dissemination, and of reaction and utilization may occur within minutes of one another" (Ratcliff, 1984, p. 8). Journal article submissions can be collected, edited, and typeset with less time and cost than in the conventional publication cycle. Some presses, like Yale University Press, make available the conventions and codes used.by the publisher's computer and typesetting equipment to save research time and money (Bogucki,1987).

Computer networking has also become an efficient and effective medium for discipline communication. McCredie and Timlake (1983) stated that discipline-based computer networks are established to provide accessibility to services, communication, and specialized resources controlled by the discipline. The Electronic Networking Committee of the American Educational Research Association uses computer networking to conduct conferences, leave messages, post all-member messages, send confidential letters, and remind members about certain issues. This stronger, more frequent interaction between discipline members due to use of computer networking may increase the quality of of idea exchange thereby improving the quality of teaching, learning and research (Ratcliff, 1984). Hiltz and Turoff (1978) wondered whether computer networkers would feel stronger ties to the discipline, or whether the cryptic nature of the computer networking would cause ineffective communication resulting in misunderstandings and negative relationships. Denning (1987) speculated that computer networking would allow translation between discipline terminologies. Computer networking allows for physically handicapped researchers to communicate with colleagues whom they may have never met due to their inability to travel to discipline conferences (Heisler, 1988).

Computer networking effects on faculty communication Studies which have investigated the effects of computer networking on faculty communication have included those which focused on computer networking's effect on traditional faculty media and those which analyzed computer networking effects on the faculty communication process.

Computer networking effects on traditional faculty communication media Computer networking, like any other type of communication medium does not operate in isolation of other media. Many researchers predicted that such traditional faculty communication media as hard copy memos, conferences, journals, telephone interaction, face-to-face interaction, and letter exchange will be replaced by faculty members' use of computer networking to communicate with distant colleagues (Catlett, 1989; Compton, 1987; Francas & Larimer,1984; Hiltz, 1984; Hiltz & Turoff, 1978; Komsky, 1988b; May,1985; Vallee & Johansen,1974). Other scholars contended that computer networking will not affect traditional faculty communication media (Hiltz, 1984; Hiltz & Turoff, 1978; Vallee et al.,1974). Hiltz called this the "add on" effect. Ratcliff (1984) agreed that computer networking will remain ancillary to the more print dominated discipline communication modes which have been the structure of the professoriate and upon which reward structures rest. A few authors argued that computer networking would increase the use of other faculty media (Hiltz; Hiltz & Turoff). Hiltz referred to this phenomenon as the "expansion" effect in that computer networking would not only work in conjunction with traditional media but stimulate more communication via all media. In 1974, Vallee and Johansen reported that the energy scientists perceived computer networking as a tool to enhance the traditional media.

In her EIES study, Hiltz (1984) concluded that changes in the use of traditional media due to use of computer networking is contingent on the level of computer use and the context. Hiltz explained that computer networking in some cases is used as a substitution for mail and/or telephone and in other cases it stimulates contacts which are made via the telephone or mail system. For example, a faculty member may use computer networking instead of the telephone to request that preprints be sent via the traditional mail system. In addition, these patterns were dependent upon the group context. Johansen, DeGrasse, and Wilson (1978) studied PLANET system users and found much complexity in the relationship between computer networking and traditional media also. Johansen et al. found that use of computer networking decreased the use of traditional mail systems while it was as likely to increase as to decrease the use of the telephone.

Hiltz (1984) also found that EIES users did not significantly affect attendance at conferences but personal visits were as likely to increase as decrease. PLANET users also showed mixed results on the use of computer networking as a substitute for travel (Johansen et al. 1978). Apparently if travel funds are unavailable, computer networking will be substituted for it. However, because computer networking develops distant (and sometimes international) relationships, it sometimes stimulates travel to meet the other person.

The effect computer networking has upon reading professional books and journals was also inconclusive. Hiltz (1984) found that computer networking was much more likely to increase academic reading, while Johansen et al. (1978) found that two of the four groups of the PLANET study reported a decrease in journal and book reading.

Hiltz (1984) found a very strong relationship between computer networking use and communication with one's local colleagues. All levels of computer networking usage reported an increase in the amount of communication they have with their local peers. Hiltz explained that perhaps the increase stemmed from users showing off or demonstrating their new "toy" or from users becoming a information link for their off-line local colleagues.

In sum, from these findings, Hiltz (1984) concluded that at low levels of system use, computer networking is likely to have an add-on effect while at higher levels of EIES use, computer networking is likely to expand the use of other media.

Computer networking effects on the traditional faculty communication process Researchers have investigated the effects that computer networking has upon the rate, publication process, connectiveness, and openness of faculty communication.

Computer networking effects on the rate of faculty communication One of the most commonly discussed issues of computer networkings' effect upon higher education is its effect upon the rate of message exchange. Hiltz and Turoff (1978) predicted that computer networking would make "possible the instantaneous exchanges of ideas, insights, advice, and suggestions" (p. xix). Computer networking could close the time gap between researchers' creation of new knowledge and publication. Most scholars agreed that computer networking allows faculty members to communicate much faster than other traditional media such as traditional mail systems, conferences or journals does (Catlett, 1989; Slatta, 1987). Slatta predicted that computer networking could speed the dissemination of news of internationally published books and articles.

Although most authors agreed that computer networking increases the pace of faculty communication, Solomon (1988) was concerned that the increased rate and unknown destination nature of computer networking would pose problems in providing proper attribution of authorship and claims of first discovery. Vallee et al. (1975) reported that ARN (Astronomical Resource Network) stamps every submitted preliminary results report with the date and time of submission in order to establish scientific precedence and trace new concepts.

Computer networking effects on the publication process Several scholars speculated on how computer networking may affect the publication process (DeLoughry, 1989). Berul and Krevitt (1974) and Aspen Systems Corp. (1974) described the feasibility of using computer networking to connect editorial processing centers where authorship, editing, reviewing, redaction, proof-reading, typesetting, and business management or the publication process are computerized. In addition, the grant process could be shorten. Computer networking is able to provide a blind review process which increases the feedback and thus the quality of the final product. DeLoughry reported that Robert Silverman, editor for the *Journal of Higher Education*, stated if journals are published electronically, more literature would be accepted due to fewer limitations on the number of available pages. In addition, Silverman argued that electronic journals would foster more scholarly collegiality because after reading the articles readers would be more likely to respond to the author, editor, and/or reviewer. A British journal, *Computer Human Factors* which has been published experimentally since the early 1980s has found a significant increase in informal communication between readers and authors after articles are published electronically. Silverman believes that the use of electronic journals may change the role of editors from gatekeepers to "enablers" . Electronic journals would democratize scholarly discourse by allowing scholars at smaller institutions and those outside of mainstream thought a chance to contribute and participate. Electronic journals would be more accepted in some disciplines than in others. Faculty members will generally be reluctant to become active until reward systems recognize electronic journals as having scholarly merit (DeLoughry; Ratcliff, 1984).

Computer networking effects on the quantity of faculty communication Nearly all researchers who have investigated the effect computer networking has on the quantity of faculty communication agreed that computer networking usage is positively related to the size and density of social networks (Freeman & Freeman, 1980; Hiltz, 1984; Hiltz & Kerr, 1981; Hiltz & Turoff, 1978, 1985; Johansen et al., 1979; Kerr & Hiltz, 1982; Palme, 1981; Panko & Panko, 1980; Rice, 1980a; Vallee et al., 1978). All nine of the evaluators of Hiltz and Kerr's synthesis of computer networking research with data on this impact supported the finding that computer networking causes an increase in communication links. Palme (1981) concluded that the increased links were with people who users perceived they would not have communicated with had it not been for computer networking. Johansen et al. reported increased connectivity within and between the 14 groups using the PLANET system. Hiltz and Turoff (1985) stated that "The most fundamental impact of a CMCS (computer mediated communication system) is to increase the social connectivity of users (i.e., the number of people in regular communication) by about tenfold" (p. 688).

Kerr and Hiltz (1982) reported in their metaanalysis, that many studies found very strong support for the impact computer networking has upon connectivity. From their analysis, Kerr and Hiltz concluded that computer networking increases the degree of personal and social connectedness with others, in terms of expanding the status set, the number of social participations and the scope of social relationships. Computer networking leads to increased collegial contacts, the number of contacts that can be maintained, and opportunities for regular connections with people.

In 1974, Vallee and Johansen conducted a quasi-experiment with groups within the Energy Research and Development and Administration (ERDA) and the Electric Power Research Institute (EPRI). Each group was allowed to communicate via traditional and computer networking media in alternating periods. The energy scientists perceived more contact with distant colleagues when using computer networking.

Freeman and Freeman (1980) used EIES to design a quasi-experiment to test the effects of computer networking on the strengths of interpersonal connection of researchers separated by geographic dispersion. The 40 researchers involved in the study were in the process of creating an interdisciplinary field of science. Networked researchers were asked to complete a questionnaire regarding their strength of interpersonal connection with each member of the network users prior to using EIES in January of 1978. In essence, the questionnaire asked researchers to indicate their relationship with every other researcher in the program; the choices were: a) heard of or read, b) met, exchanged letters or phone calls, or computer conference with, c) friend, d) close personal friend. For seven months, Freeman and Freeman tabulated each researcher's use of EIES to communicate with fellow researchers at different geographical locations. After the seven month period, the respondents were asked to fill out the same interpersonal connection questionnaire. Using correlation statistics, Freeman and Freeman found a positive relationship between level of EIES usage and interpersonal linkage. Not only did these results show that high EIES users were more aware of each other and created more new friendships, but the few cliques which were revealed in the first questionnaire evolved into overlapping cliques and an overall pattern of increased closeness for the whole group. Freeman and Freeman presented the results cautiously due to the confounding effects of history, maturation, and testing and instrumentation in this uncontrolled experiment. In addition, the results can only be generalized in a limited nature because of the newness and interdisciplinary nature of the field being studied; both of these aspects would stimulate more communication than a stable discipline where norms, goals, and procedures are mostly determined. Freeman and Freeman also found that those who had established the friendship prior to use of EIES (via mutual institutional ties or at the initial face to face meeting) showed greater gains in their relationships; this implies that computer networking may be more useful in maintaining relationships after initial face-to-face contact.

In 1981, Panko and Panko surveyed 231 users of DARCOM's (U. S. Army Material Development and REadiness Command) EMS (Electronic Message System). The respondents reported the most strongly experienced benefit of the computer networking system was the effect of increased long-distance communication.

One of the variables addressed by Hiltz in her 1984 conclusive report was the effect of computer networking upon connectiveness. She based her conclusions on data collected from EIES as well as from similar systems (see Edwards, 1977; Hiltz, 1981; Palme, 1981; Rice & Case, 1981; Vallee et al., 1978). Hiltz (1984) found a weak to moderate curvilinear relationship between connectivity and amount of computer networking use. Hiltz made these conclusions by comparing the subjects' self report on number of co-authorships within the last year, extent to which the scientist considered self in "mainstream", number of contacts in specialty with the level of EIES use. She concluded that neither the isolates nor the stars of the groups use computer networking as much as those with moderate connections who are more motivated to increase their connectiveness. Likewise, knowing many members on the EIES prior to participating on the EIES was a very strong predictor of high levels of EIES use. Hiltz deduced from this statistic that subjects used the system to maintain and increase ties with their acquaintances. The majority of EIES users reported more communication with other EIES users than they would have had they not been on the system. However, three-fourths of the subjects said that EIES had no effect on the amount of communication they have with colleagues not using EIES. A significant minority even reported an actual increase in quantity of communication with their non-EIES colleagues; Hiltz deducted that this increase may be due to the subject's new role as informational relay about and from the system to nonusers.

Hiltz and Turoff (1978) questioned whether computer networking would motivate scientists to enter into discussions with others' about their embryonic work. Many scientists informally give and take ideas at conferences or in conversation that are later used in publications but not cited due to the author's forgetfulness as to where the idea originated. With computer networking, these ideas could be documented and thus be cited in works. This type of recognition may cause researchers to share more. On the other hand some may stay clear of this format whereby ideas can be stolen by others and no recognition received.

Apparently, computer networking sometimes increases communication so much that users experience feelings of information overload. According to Hiltz (1984), those in the middle range of use experience the most feeling of overload. Apparently those at the low end of the usage continuum have not yet communicated enough on the system to experience overload and those at the high end have developed effective coping mechanisms. Rogers (1986) found Stanford University computer networkers bypassing layers of organizational structure and creating information overload for administrators; after the novelty wore off, these two variables decreased. Overload problem-solving pivots around the necessity to protect the increased communication links generated by computer networking while attempting to decrease the unimportant and time-consuming information sometimes sent through these links (Hiltz & Turoff, 1985).

Johansen et al. (1978) and Vallee et al. (1974) comprise a minority of researchers who did not support the conclusions that computer networking increases connectivity and communication quantity. Both research groups found that although some computer networked groups did increase their number of contacts, others did not. Johansen et al. concluded that motivation to communicate with other participants also plays a role in whether computer networkers experience an increase in connectiveness.

Computer networking effects on the openness of faculty communication

Some researchers have speculated whether computer networking will excommunicate those discipline members who do not use the system or will their colleagues who use computer networkers motivate more participation from all discipline members. Hiltz and Turoff (1978) wondered if the nonusers would be influenced to become computer networkers due to the circulation of printed computer networking output, encouragement of non-users to try the system, more free time to communication in the more traditional modes, and an increase in the number of face-to-face conferences which become a consequence of communicating via computer networking.

The utilization of computer networking could level the stratification of the haves and have nots of disciplines by giving equal opportunities to the less known researchers at smaller institutions a voice in research ideas and projects and decrease the power of powerful research institutions. Thus those at smaller institutions could increase their productivity due to the increased stimulation caused by improved peer-group communications (Hiltz & Turoff, 1985). Some scholars also predicted that computer networking would open up invisible colleges for physically handicapped scholars as well as international scholars (Aspen Systems Corp., 1974; Berul & Krevitt, 1974; Slatta, 1987). Johansen et al. (1978) predicted that computer networking could produce an electronic barrier whereby some would be invited to join the deliberations while others would be excluded. However, the data from the Johansen et al. studies showed more diverse contact for junior faculty members who attempted to gain status quickly by building their own collegial networks.

Other researchers focused not only upon the increase in connectivity attributed by computer networking, but also upon the cross-organizational nature of the connections (Bamford & Savin, 1978; Hiltz, 1984; Kerr & Hiltz, 1982). Bezilla and Kleiner (1980) and Bezilla (1979) found computer networkers experience an exponential growth in the connectivity of their professional and social circles due to continuous interaction with previously developed contacts and with a number of new links from new networks. Hiltz (1981) reported that 44% of the 103 respondents from one of the EIES studies claimed they increased communication with peers from other discipline areas. Hiltz and Turoff (1978) also argued that computer networking is an effective medium for interdisciplinary research for it allows researchers to move in and out of areas easily; interdisciplinary researchers in emerging areas can benefit from communicating with each other via computer networking without the pressure to become a formal society or publish a journal.

Faculty Culture

If technologies such as computer networking do change the way faculty members communicate, then it is essential to next ask about the consequences of such communicative change. One area being investigated by organizational communication researchers (Danowski, 1980; Goodell, Brown, & Poole, 1989, Pfeffer, 1981; Pickett & Sorenson, 1983) is the relationship between communication quantity and the cultures organizational members share. In essence, researchers found that communication quantity between organizational members is positively related to mutual perception of the culture of the organization.

In order to set a theoretical background for this line of organizational communication research, literature which describes the interpretive paradigm, which is the foundation for cultural research, is reviewed. Next, literature which explains the philosophical basis for assessing organizational cultures is discussed. And finally literature which addresses the effect of communication on culture is reviewed. This section ends with a review of higher education literature supporting the necessity of examining changes in both the shared cultures of faculty members' discipline and institution.

The interpretative paradigm

From an interpretative framework, organizations are seen as a product of subjective and intersubjective activities of the organizational members (Burrell & Morgan,1979). Research focuses upon shared and multiple reality making and changing. Meanings are determined by mutual-experiencing which is recorded symbolically. Such experiencing is really culture-creating. Geertz (1973), one of the leading researchers in the cultural perspective, believed that an organization's culture includes the organizational members' beliefs, assumptions, rules, customs, and practices. Such elements guide not only the behaviors of organizational members but also guide their interpretation on the meaning of such behaviors in that particular setting. Organizations "are" cultures rather than "have" a culture (Schall, 1983). According to Schall, the organizational culture is:

> . . . a relatively enduring, interdependent symbolic system of values, beliefs, and assumptions evolving from and imperfectly shared by interacting organizational members that allows them to explain, coordinate, and evaluate behavior and to ascribe common meanings to stimuli encountered in the organizational context; (p. 557)

Higher education scholars, who as a group in the past have worked under a more functional perspective, have recently begun to embrace a more interpretative view of institutions (Becker, 1963; Birnbaum, Bensimon, & Neumann, 1989; Bushnell, 1960; Chaffee, 1985; Chaffee & Tierney, 1988; Clark, 1970, 1971, 1980, 1984; Deegan, Steele, & Thelin, 1985; Dill, 1982; Masland, 1985; Meloy, 1986, Pace, 1962; Peterson et al., 1986; Redinbaugh & Redinbaugh, 1983; Sanchez, 1987; Schein, 1985; Tierney,1988). According to these researchers, the interpretative perspective is valuable for it is able to anticipate, understand, and manage the consequences of institutional responses to the current turbulent times in higher education. Clark (1980) said:

> In pursuing selectively the complex realities of higher education, there is considerable gain at the present time in turning to the most relevant disciplines and the perspectives that they cultivate and bring to bear. ...no one approach can reveal all; broad accounts are necessarily multidisciplinary, with all the lights turned up and the eye wandering back and forth across the broad stage. But the disciplinary view is compellingly necessary, since it is in the power of approaches and ideas developed by specialists that we find the cutting edge. And so it is in the study of higher education. If we did not have at hand different analytical visions for

> that study, the ways of looking provided by history and political science and economics and organizational theory and so on, we would have to invent them (p. 2).

According to Chaffee and Tierney (1988), dimensions of organizational culture include: values, beliefs, norms, priorities, structures which influences activities, and members' enactment of their environment. These become the "strands in the web of meaning" (Chaffee & Tierney, p. 6). To study an organization, the investigation must focus on what is done, in what manner, and by whom; this includes actions, decisions, and communication. Specifically, the shared assumptions of the organization can be found in an analysis of the stories, language, norms, ideology, and artifacts of the members' individual and collective behaviors.

> Communication is the primary vehicle through which members perceive and interpret their world, so it is the *sine quo non* of organizational culture. Oral and written discourse and a host of nonverbal acts provide clues through which we can better understand the cultural dimensions (p. 45).

Therefore, the basis of the interpretative approach to studying higher education institutions is the interaction or communication of its members. Clark (1983) believed that the core of a discipline was their "common vocabulary"; and argued that one way to study changes in a discipline was to study changes in their communication. Smircich (1981) argued that cultures are the product of organizational members' interpretation of their organizational experiences and then the sharing of these interpretations with other organizational members. Cultures are transmitted to new members as well as maintained and changed by old timers via verbal and nonverbal communication. Becher (1984) argued using Wittgenstein's (1922) guide "the limits of my language means the limits of my world" to argue that change in either communication or in perception of an organization will affect the other. For without communication, the components of culture -- norms, reminiscences, stories, rites, rituals, constructs, vocabulary, facts, expectations, strategies, and myths would not exist (Schall, 1983). In summary, those researchers who investigate organizational culture within the interpretative paradigm, see organizations as cultures and cultures as created by and maintained by communication.

Many scholars have advocated that more computer networking research needs to be conducted from the interpretative paradigm (Compton, 1987; Featheringham, 1977; Hiemstra 1982, 1986; Hiltz & Turoff, 1978; Hirschheim, 1985; Johansen et al., 1979; Nilles, 1975; Sproull, Kiesler, & Zubrow, 1987; Uhlig, 1977).

Hiltz and Turoff (1978) believed that computer networking could provide opportunity to do ethnography studies of disciplines by allowing the researcher to examine the transcripts of conferences between opposing disciplines for the arguments defending the discipline' s basic theoretical and methodological beliefs.

Hiemstra (1986) stated that much of the research in "interactive technologies" (of which computer networking is one) has focused "on task effectiveness, usage patterns and user responses, and simple objective communication differences" (p. 208). Instead, Hiemstra insisted that more research on technologies like computer networking needs to focus upon "the intersubjective world of actual users" (p. 209). In his 1982 work, Hiemstra explained that organizations are cultures which are based upon symbols and meanings; hence, since technologies like computer networking are designed to "affect the transmission of symbols and meanings, the revolution in information technology has the potential to alter the culture of an organization profoundly" (p. 874). Hiemstra ended with a suggestion that researchers examine how interactive technologies affect organizations by using Harris and Cronen's (1979) master contract approach.

Philosophical basis for assessing organizational cultures

Wacker (1981) suggested that an innovative and valuable means of assessing organizations would be to to uncover the organization's culture by discovering the organization's cognitive infrastructure or the constructs organizational members use in interpreting the meaning of organizational events. Wacker rested his suggestion on Argyris' (1964), Kanter's (1977) and Schon's (1971) work which argued that organizational members' behaviors are affected and directed by commonly held cognitive constructs of the organization.

In order to elicit the cognitive constructs of organizational members, Wacker (1981) adapted Kelly's (1955) personal construct theory and methodology. Kelly, a practicing psychotherapist, developed and used an instrument called the repertory grid to uncover the ways his patients ordered and organized their lives; his hope was that such an instrument could help patients to understand their worlds better and how they could change them (Bannister & Mair, 1968). Kelly 's repertory grid theoretically stemmed from his personal construct theory. Kelly postulated that that reality itself does not have meaning but rather is a function of cognitive constructions which people erect in order to classify and organize environmental phenomenon and thus make sense of it (Bannister & Mair; Crockett, 1965). Banister and Mair explained personal construct theory:

> Man can only come to know the world by means of the constructions he places upon it and he will be bound by events to the extent that his ingenuity limits his possibilities for reconstruing these events. Each man erects for himself a representational model of the world which allows him to make some sense out of it and which enables him to chart a course of behavior in relation to it (p. 6).

This is the same underlying postulate that guides interpretative research.

Banister and Mair (1968) explained that constructs are the way in which people see some phenomenon as being alike and at the same time different from other phenomenon. This nature of constructs is the heart of the Kelly's repertory grid whereby subjects are asked to name elements which fall into the topic being studied, i.e., job responsibilities or acquaintances, etc. Then subjects are asked to describe how two of the named phenomenon are alike yet different from the third. This type of triadic sort is repeated for several sets of the phenomenon under study and the outcome to the comparisons is the naming of some of the subject's constructs for that phenomenon. When a sufficient number of constructs is elicited, they are arranged on a matrix or "grid" along with the phenomenon being compared. For example, if social cognitive constructs are being uncovered, all of the people mentioned by subjects are listed on one axis and all of the constructs elicited from the triadic sorts are placed on the other axis. Then subjects rate how each of the phenomenon is characterized or is defined by each of the generated constructs using a Likert-type rating scale. The grid is then factor analyzed and the constructs are plotted on a construct map. The map is presumed to represent a portion of the subject's construct system (Bannister & Mair, Crockett, 1965).

In the mid 1970s, communication scholars and researchers began to integrate Kelly's construct philosophy and methodology into their attempts to explain the relationship between communication and constructivism. Delia (1977), a communication scholar, argued that constructs are a product of communication.

> A constructivist approach to social interaction, accordingly stresses the interplay of shared and individual interpretive processes by which individuals define situations and construe the perspectives of others within them in making the anticipations necessary to joint conduct and coordinated creation of shared meaning (p.70).

Therefore, by communicating with others, persons mix their own ideas of the phenomenon with the ideas they perceive others as having in order to share meanings and coordinate behavior.

Harris and Cronen's (1979) research was theoretically based upon both communication scholars' approach to constructivism and Kelly's personal construct theory. Harris and Cronen posited that organizations can be analyzed by identifying their mutually defined "master contract". Organizational members are continually involved with a process of building a master contract of what organizations are and are becoming by interacting with other organizational members then drawing conclusions or meanings about the interactions. The master contract is the organization in that it is created and maintained by the imperfectly shared beliefs and goals of members. This socially mutual construction of "we" governs the ways members act, interact, and interpret acts and interactions of others. Thus communication is the source of the master contract and that which is governed by it.

Harris and Cronen (1979) adapted Kelly's repertory grid to uncover these organizational mutually created and held master contracts. One element of the master contract is organizational constructs. Harris and Cronen used Kelly's (1955) idea of constructs to describe the manner in which organizational members build the organizational image of this master contract of the organization. In general, constructs give order to human's worlds by providing a discriminating means by which to see and store differences and similarities in phenomenon. Constructs are composed of dichotomous terms. For example, a faculty member may measure his or her institution by the amount of innovation they perceive in organization; this person may then use a "innovation-----status quo" construct by which to describe the institution.

Another element of the master contract is the individual beliefs and goals organizational members hold of their organization. Members articulate their organizational beliefs by defining where their organization falls on the various constructs and their organizational goals by expressing the ideal place of the organization on the constructs.

Harris and Cronen (1979) conducted a case study of in a social science department in a Massachusetts college in an attempt to uncover the master contracts organizational members make and maintain. In order to determine the set of constructs members of the department used to define the department, members were interviewed; each was asked the following questions :

1. What in your opinion makes your organization unique among organizations similar to it?
2. In what ways is it similar to other organizations?
3. How would you describe your organization when it is at its very best?
4. How would you describe your organization when it is at its worst? (Harris & Cronen, 1979, p. 22)

Subjects were asked for the opposite of their answers to the above questions in order to obtain the whole construct. Such a battery of questions was similar in function to the triadic sorts of Kelly's repertory grid where subjects are asked to find the similarities and dissimilarities between phenomenon under study.

Independent raters sorted the responses into functionally equivalent constructs. Ten of the generated constructs were selected for the second phase of the study. Each of the 10 constructs was converted to a nine point scale bound by the dichotomously-phased constructs generated in the first phase of the study. Each of the subjects was asked to answer the following questions by indicating a number on the construct continuum.

Scientific _ _ _ _ _ _ _ _ _ _ Humanistic

1. Indicate the space that best represents what you personally believe to be the ideal of your organization.
2. Indicate the space that best represents what you believe most others

in your organization believe to be the ideal of your organization.

3. Indicate the space that best represents what you personally believe to be the actual state of your organization.

4. Indicate the space that best represents what you believe most others in your organization believe to be the actual state of your organization. (Harris & Cronen, 1979, p. 23)

Harris and Cronen (1979) then used Wilcoxon tests to determine differences in subjects' perspectives and their ability to understand the view of their colleagues. In this case study, Harris and Cronen found that department members shared similar constructs but not beliefs and ideal states. In addition, they were not always able to accurately understand the views of others in the department.

The effect of communication on culture

Several theorists have argued that communication quantity and organizational culture are directly related to each other. Price (1975) quoted Gordon Thompson as stating that networking "increases the size of the common 'information space' that can be shared by communicants and raises the probability of discovering and developing latent consensus" (pp. 499-500). Likewise, Pfeffer (1981) theorized that "more frequent communication intensity is likely to be the development, through informational social influence, of a more common set of understandings about the organization and its environment" (p. 19). According to Pfeffer, such an organizational consensus can be measured by observing a consequence of the consensus such as "institutionalization of beliefs, structures, and activities" (p.19).

Other researchers have empirically tested the relationship between communication quantity and organizational culture. Danowski's (1980) work addressed one portion of shared organizational culture and communication amount by investigating the relationship between connectivity and attitude-belief similarity. Danowski began by examining several studies which showed that as group cohesiveness increases, the number of messages exchanged among group members increases (Bovard, 1951, 1956a, 1956b; Deutsch & Collins, 1958; Sherif & Sherif, 1953). Danowski reinterpreted the results of these studies by redefining "number of messages" with "connectivity" and thus designed his general hypothesis: as connectivity increases so too does attitude-belief uniformity. Danowski refined his hypothesis one step more by arguing that the content of the communication network needed to correspond to the content of the set of attitudes and beliefs. He then asked 963 employees of a large eastern financial institution to complete a survey identifying people within their division with whom they communicated about production, maintenance, and innovation and to indicate the frequency of their interactions. (Content categories were defined by preliminary qualitative interviews.) Connectivity levels were assessed using NEGOPY network analysis program and correlation tests were used to reveal the relationship between the connectiveness and uniformity in attitudes and beliefs variables.

Danowski's (1980) results showed that communication network users who discussed production and innovation topics were positively related to connectivity with the production network being the strongest of the two. The maintenance networks revealed showed little association between connectivity and attitude and belief homogeneity. However, within each of the content networks, various relationships emerged. For example, employees in production networks were less homogeneous on their attitudes toward the task while more homogeneous in their attitudes toward socio-emotional issues. Those in innovation networks were homogeneous in their attitudes toward both task and socio-emotional issues. In production networks and in innovation networks, homogeneity in attitudes toward personal issues decreased with an increase in connectivity. Therefore, Danowski concluded that the relationship between connectivity and uniformity of attitudes and beliefs is dependent upon the type of communication task being accomplished.

Goodell et al. (1989) examined the relationship between communicative quantity and climate or cultural perceptions of the the organization. The purpose of the research was to empirically test Newcomb's (1953) theory that communication "performs the essential function of enabling two or more individuals to maintain simultaneous orientation toward one another as communicators and toward objects of communication" (p. 393). Or as Goodeil et al. paraphrased the Newcomb's theory - "Members of organizations create and sustain socially defined climates through the process of coorientation" (p. 4). In order to test for a "positive relationship between linkages in organizational communication networks and perceptions of organizational climate" (p. 5) in a realistic setting, the site of their first study was a large financial planning organization. In order to test the hypothesis "The relationship between network participation and attitude toward climate will change over time as a function of organizational interactions" (p. 6) Goodeil et al. used a ten-week simulated organization. While the results of the first study implied a positive relationship between network participation and climate perceptions, the closeness of several cells in the contingency table indicated that intervening variable may have affected this relationship.

The results from the Goodell et al.'s (1989) second study showed that a relationship between network linkage and climate existed at only the second of four points in the time of the simulated organization's life span. The data seemed to indicate the relationship between linkage and climate perception was strongest during the role and norm creating phase of the organization; the disorganization of the first time phase and the comfortability with norms and roles of the third and fourth phases precipitated the weaker relationship between the variables. These researchers concluded that the relationship between network linkage in an organization and the commonly held perceptions of the organization's climate is positive yet complex and varies over time

Pickett and Sorenson (1983) used Harris and Cronen's (1979) methodology to study the affects differences in communication patterns of two separate organizations may have on their master contract-making. Simulated bureaucratic organizations were created with the help of students in an organizational communication class in a large midwestern university. The goal of the organizations was to see which could make the most profit in the sale of fireworks. The organizations ran simultaneously for four ninety-minute class periods. in order to measure the independent variable, organizational members were asked to describe their amount and type of communication with fellow organizational members via quantitative and qualitative measures. Pickett and Sorenson used the same methodology used by Harris and Cronen with the exception of comparing two groups instead of one. Also, Pickett and Sorenson asked the construct questions via a survey. Results from Pickett and Sorenson's study showed a positive relationship between type and amount of communication between organizational members and their master contracts of organizational image and coorientation. The one organization which was strongly interconnected possessed a "collective frame for making sense of their experience" (p. 17). The other organization which appeared less interconnected failed to share a "collective interpretive scheme" (p. 17).

Dual organizational membership of faculty members

Many researchers have generally described the American professoriate (Bowen & Schuster, 1986; Caplow & McGee, 1958, 1968; Casanova, 1987; Cheit, 1971; Finkelstein, 1984; Jencks & Riesman, 1968; Kerr, 1963; Ladd & Lipset, 1979; Lazarsfeld & Thielens, 1958; Trow, 1975; Wilson, 1942;1979). However, one of the most unique features of the professoriate is the fact that faculty members can not be studied as members of just their institution or just their discipline. Instead, they must be conceived as simultaneous members of two major organizations: the discipline and the institution (Becher, 1987; Blau, 1973; Casanova, 1987; Clark, 1987a, 1987b; Light, Marsden, & Corl, 1985; Gregory, 1983; Gumport, 1987; Kuh & Whitt, 1988; Metzger, 1987; Ruscio, 1987; Van Maanen & Barley, 1984).

The following sections describe the literature which has described the historic evolution of this dual organizational membership of faculty members, the interactive effects between faculty members' disciplinary and institutional membership, and the relationship between organizational consensus and paradigmatic development.

The historical evolution of dual organizational membership of faculty members

Many scholars argued that diversification of both disciplines and institutions was the cause of this dual membership phenomenon (Bowen & Schuster, 1986; Clark, 1987a; Freedman, 1979). Diversification of institutions began in the move from the colonial college to the university. In the colonial college, ministers served as presidents and young pulpit-less clergy served as the tutors (Clark). The trustees, who were elders of the church and state, determined what would be taught, who would teach it and how much the tutors would be paid. Colonial colleges were modeled after the British institutions where the tutors were expected to teach any and all of the classic courses (Finkelstein, 1984; Jencks & Riesman, 1968). This early type of institution grew rapidly in the early and mid 1800s due to a westward-moving frontier and religious evangelism. By 1900, there were around 900 private colleges across the country following the classical curriculum and granting bachelor's degrees.

In 1876, Johns Hopkins was established as the first university in the nation and many other colonial colleges began evolving into universities (Clark, 1987a). With the university, came the uniquely American formal graduate school structure and a new emphasis on research. Most universities offered students both an undergraduate and graduate curriculum. Undergraduate programs were needed to financially subsidize the work of scholars in the graduate programs (Ben-David, 1977; Clark). Faculty in the early universities were pleased to be able to occasionally shift from teaching general or elementary undergraduate classes to more specialized graduate courses where they could remain on the cutting edge of scholarship.

In addition to the university, other types of higher education institutions emerged to diversify faculty members. In the 1860s, higher education expanded its mission of training "gentlemen", teachers, preachers, lawyers, and doctors by developing land grant state universities to meet the educational needs of more practical professions like agriculture, forestry, engineering, and home economics. In addition, land grant schools were to provide educational services for community members, or extension services. Prior to 1900, public institutions to train teachers were developed. By the 1940s these normal schools evolved to offer more than just teacher education programs and became known as "comprehensive colleges" (Clark, 1987a). According to Clark, the comprehensive college offered nearly as many programs as the universities, however, there were fewer "esoteric, scholarly specialties and more occupational ones" (p. 11).

At the turn of the 20th century, yet another type of institution was developing -- the two-year community college. The mission of this type of institution was to provide the first two years of college for students planning to finish their bachelor degree at a 4-year college or university as well as to offer terminal vocational programs. In essence, the comprehensive community college has become a home for adult and community education offerings. At the 1,000 plus community colleges in the United States, faculty spend the majority of their time teaching with very little time left over for research activities.

In addition, disciplines have grown and diversified. The roots of discipline diversity extend to the specialized guilds of Europe nearly eight centuries ago. The colonial college which offered only the classical curriculum attempted to suppress specialization of scholars. However, when American tutors returned with advanced degrees in specialized research programs from German and French Universities, specialization of the disciplines began and has been growing at an accelerated rate ever since (Clark, 1986, 1987a; Finkelstein, 1984; Goodchild, 1986; Jencks & Riesman, 1968). According to Clark (1985), today the professoriate is "variously positioned in" different types of universities and scattered amongst a "plethora of disciplines and a host of subcultures that speak in strange tongues" (p. 158). Clark argued that that the major causes of such speedy growth in academic specialization are: parturition of various subject areas due to an increase in new material and a commitment to professional education programs. Metzger (1987) stated "between 1870 and 1900 practically every subject in the academic curriculum was fitted out with new or refurbished external organization -- a 'learned' or 'disciplinary' association, national in membership and specialized in scope" (p. 136). In Clark's 1987a piece, he speculated that nearly 200 disciplinary specializations exist in higher education today.

> Beginning in the last half of the nineteenth century, the American system of higher education moved rapidly into a luxuriant garden of subjects, as Walter Metzger pointed out, generous to a fault in admitting to the curriculum even the arts of the home and battlefield while expanding and subdividing old fields of study at an accelerated pace, driven by a competition for scholars and students that was to intensify rather than lessen as the twentieth century wore on (Clark, 1985, p. 157).

In sum, the historical diversification of both institutions and disciplines sets the scene for faculty members' dual loyalties to both their disciplines and institutions. Because institutions vary greatly in their expectations of faculty members and because disciplines have also become very specialized, faculty members need to keep involved with both organizations in order to be effective.

The interactive effects between faculty members' disciplinary and institutional membership The influence of the institution and the discipline are related in a complex manner. "Disciplines and institutions connect as well as divide academics" (Clark, 1987b p. 371). Both disciplines and institutions influence and are influenced by faculty members for both organizations "...shape their work, call upon their loyalties, and apportion their authority" (Clark, 1984, p. 112). Clark contended that members of no other profession experience such a division of energies and loyalties between two organizations with the same scope and intensity which faculty members do. The only professions which come close to this same organizational setting are independent research labs and R&D departments in business and industry.

Disciplines are "fields of inquiry" (Reither, 1986) or "language communities" (Kuhn, 1970) where knowledgeable peers converse in a "common tongue" (Clark, 1985) in order to construct the knowledge and the vehicles of knowledge which discriminate one discipline from the other. A common culture is held between discipline members in their mutually shared assumptions on what is knowledge, how is it created, what is quality academic performance, and what is professional interaction and publication (Kuh & Whitt, 1988; Reither). The culture of the discipline is learned early in the lives of potential faculty members. Values toward discipline membership are formed before and during graduate school. Members of disciplines which require more specialized training use the discipline as a resource for not only expertise but also identity-building. In turn this discipline-governed process causes a stronger bond between the member and the discipline than the member and their institution (Blau, 1973; Clark, 1984; Kuh & Whitt; Morrill & Spees, 1982).

The bonding between discipline members is eventually affected by the institutions which employ discipline members as faculty members. Because the employing institution is chosen after years of discipline culturalizing, in order that the discipline member may practice in his/her field, Ruscio (1987) argued that institutions are an "obligation". The institution's effect on discipline membership varies by the mission of the institution. In 1982, there were 2661 postsecondary institutions in the U.S with varying missions. In the American higher education system, the research university places more value on research than teaching and thus faculty members become more oriented to the discipline. However, in American community colleges, teaching is the main mission. Because community college faculty members are asked to teach many classes which encompass a broad spectrum of one or more disciplines, they are unable to build strong bonds in specialty areas. Casanova (1987) reported interest in research activities had increased in faculty members across all institutional types and that institutions influence faculty members to be active researchers by providing time, funding, assistance, instrumentation, library resources, leaves, travel, and access to disciplinary communication structures.

Institutional goals of specialized or liberal education affect faculty members' affiliation with their disciplines. For example, faculty members at an independent liberal arts institution in the United States are likely to be less oriented to their discipline than those at a specialized university. Likewise, graduate faculty members are more likely to show more affiliation toward their discipline than undergraduate faculty.

The size of the institution will also determine the effect it has upon disciplines. Larger institutions have less unified faculties with more loyalties given to subcultures than to the institution. Faculty members at small liberal arts colleges are limited in their interactions with members of their discipline or specialty area due to heavy teaching loads and few colleagues in their departments; in this situation, the faculty member loyalties to the discipline are in direct conflict with their loyalties to the institution (Clark, 1963, 1983, 1984). Blau (1973) found that institutional loyalty was greatest in small, private institutions in the Northeastern section of the United States.

In addition, various institutional policies and power structures affect institutional structure which affects where discipline members will be housed within the institution thereby fragmenting the discipline more (Clark, 1984, 1987a, 1987b; Ruscio, 1987). For example, by institutional tradition or policy, physicists may be located all within the same department, scattered between several interdisciplinary schools, or located at many separate sites. Hagstrom (1965) found that the higher the rank of the department, the stronger orientation its members would have to their discipline.

Clark (1987a) stated that the rewards of the institution powerfully shape disciplines because they influence some faculty members to have local rather than cosmopolitan orientation.

Disciplines also affect institutions. Disciplines tend to pull faculty members away from their "local" links and toward more "cosmopolitan" connections with members of their disciplines. Clark (1987a) argued that the consensus level of disciplines affects the institution by the efficiency of departmental management. "Departments that operate with well-developed, accepted bodies of knowledge can arrive at a consensus more readily than those confused by ambiguous materials and conflicting perspectives" (p. 168). In addition, the general status of a discipline affects the institutional clout of various departments.

Although it is clear that faculty members' simultaneous membership in both the discipline and institution are interconnected, the dominance of one of the two organizations to faculty members is not as clear cut.

Ruscio (1987) used a biological metaphor to describe the relationship between these two organizations. Like the genotype in biology represents the potential for development and the phenotype represents the actualization of the potential within an environment, so too does the discipline represent the genotype or body of knowledge which is practiced within the diverse institution in the U.S. or the phenotype. Ruscio argued that the importance of both the discipline and the institutional is consistent with the nature-nurture debate in which the middle ground is now reaching some agreement. Nature provides a blueprint from which a structure may or may not be built -- the determining factor is the environment which encourages or inhibits growth.

A classical study by Gouldner (1957) also attempted to describe this unique academic relationship. Gouldner found that some persons become more loyal to the institution ("locals") and some feel more obligation to the discipline ("cosmopolitans"). Specifically, Gouldner reported that cosmopolitans and locals differ in degrees of influence, participation, propensity to accept or reject institutional rules and informal relations. Casanova (1987) described the "cosmopolitan" faculty member as one with "norms and values associated with discipline standards rather than institutional standards; involvement in the 'network' of disciplinary scholars; and sharing the value structures of the group..."(p. 118).

Although faculty members are active members of both organizations, most scholars agree that in the United States, faculty members are more influenced by their discipline connections rather than their institutional ties (Clark, 1963; Kuh & Whitt, 1988; Turner,1971). Freedman (1979) found that a sample of Berkeley University faculty members saw themselves more as discipline contributors than as teachers of their disciplines. Light et al. (1985) argued that the discipline dominates because it designs the criteria for institutional success or failure. According to Clark (1984), "As a result, a national system of higher education may be and often is as much a set of disciplines and professions as it is a set of universities and colleges" (p. 113).

The relationship between organizational consensus and paradigmatic development

According to Kuhn's (1970) classic work on paradigm development, various disciplines differ in the maturity or paradigmatic development. According to Kuhn, a paradigm is "the entire constellation of beliefs, values, techniques, and so on shared by the members of a given [scientific] community. A paradigm is what the members of a scientific community share, and conversely, a scientific community consists of men who share a paradigm" (Kuhn, pp. 175- 176). This degree of discipline consensus stretches over a field's theory, methodology, techniques, and problems. Kuhn went on to state that the physical sciences have more developed paradigms than the social sciences.

In order to test Kuhn's (1970) contentions, Lodahl and Gordan (1972) collected data on the degree of agreement over discipline content from 80 university graduate departments of physics, chemistry, sociology, and political science. First, the researchers verified Kuhn's notion of paradigm development by asking subjects to rank their own field against the other three in terms of consensus over theory, methodology, and training; physics was ranked as having the most consensus and chemistry second highest. Next, Lodahl and Gordan found a greater degree of agreement on field content in these more developed disciplines (physics and chemistry). Finally, the degree of differentiation into subfields was addressed. Chemistry showed the highest level of differentiation while physics and sociology showed moderate levels; political science appeared relatively undifferentiated.

The effect computer networking might have on the level of paradigm development was one of the early questions queried by such speculative writers as Hiltz and Turoff (1978). These researchers wondered if the use of computer networking would increase the rate of creation of invisible colleges or shared paradigms, thus creating a flood of research activity and breakthroughs. Hiltz and Turoff predicted that computer networking would aid in developing and resolving of discipline controversies (a vital feature of science) due to the intensified and complete discussions made available via computer networking. In addition, Hiltz and Turoff predicted that computer networking would increase participation (especially by deviants and neutrals) and thus the speed of resolution because computer networking is perceived as a less intimidating medium than face-to-face. In addition these researchers wondered how computer networking might be helpful in tracking the evolution of scientific controversy.

Summary of Literature Review

Although each of the pieces sited within the literature review is important in considering the effects computer networking has on faculty communication and culture, a few pieces of literature provided the most focus for this study. Hiltz's (1984) conclusive work on the effects of computer networking on communication patterns emphasizes the necessity to explore the relationship between this technology and interaction patterns. Harris and Cronen (1979) presented the cultural concept of examining organizations by examining the manner in which members build and share a master contract. Pickett and Sorenson's (1983) study studied the difference between master contract-making in two groups and and investigated how changes in communication affect changes in master contract-making. Clark's (1987a) recent work on the professoriate in general and the relationship between the discipline and institution, provided background for a study set within the higher education setting.

CHAPTER III. METHODOLOGY

Introduction

This study appears somewhat complex for it used both quantitative and qualitative methods which required the use of a two-phase survey. Such methodological triangulation compensates for the weakness of any one single measure (Williams, Rice, & Rogers, 1988). Denzin (1978) advocated using multiple methods in order to capture a more complete picture of the phenomenon. While quantitative methods and analysis were used to measure changes in faculty communication, both qualitative and quantitative methods and analyses were used to assess changes in faculty culture.

In order to utilize both types of methodologies, a two-phase survey was necessary. The first phase of the survey, asked subjects questions concerning demographic data and their perceptions of changes in their communication. In addition, the last sections of the the first phase of the survey asked subjects open-ended questions which would expose the constructs subjects use to make sense of their discipline and institution . Independent raters then categorized the responses of these open-ended questions into functionally equivalent categories of constructs (qualitative analysis). The second phase of the survey asked additional questions concerning subjects' perceptions of changes in their communication. In addition, the last sections of the second phase of the survey asked subjects to rate each of the common constructs which they had generated in first phase. These ratings were then analyzed using quantitative analysis.

In summary, the first sections of both the first and second surveys collected data on perceived changes in communication due to computer networking and the last two sections of both phases of the survey, used a grounded approach complemented with quantitative measures to explored changes in faculty culture due to computer networking.

This chapter on research procedures contains a description of the subjects, instrumentation, procedures and the data analysis used in this study.

Subjects

The subjects of this study were members of the astronomy discipline who are also members of astronomy departments in research universities I.

According to the Carnegie Foundation for the Advancement of Teaching's 1987 taxonomy of higher education institutions in the United States, 70 Institutions are classified as "research universities I" ("Carnegie foundation," 1987). Research universities I offer a "full range of baccalaureate programs, are committed to graduate education through the doctoral degree, and give a high priority to research. Each receives at least $33.5-million in federal support and awards at least 50 Ph.D. degrees annually" ("Carnegie foundation," p. 22). Members of research universities I were selected due to their research responsibilities. Research requires faculty members to communicate with their discipline peers who may geographically dispersed. Therefore, it seemed that a greater number of faculty at research universities I may be using computer networking to accomplish this sort of communication task. In addition, the available literature on the faculty communication process focuses upon faculty members with major research responsibilities.

The selection of the astronomy discipline was made with the help of experts. First, two directors of computer networking at Iowa State University's computation center were interviewed to find out which disciplines on that campus were heavy users of computer networking (Covert, 1989; Howbert, 1989). Engineering and astronomy were found to be very heavy users. Since subjects needed to be faculty members at research universities I, and since engineering is more of an applied discipline and astronomy is more of a pure discipline (Becher, 1987), astronomy was selected as the more appropriate the discipline to investigate in this type of an institution. An Iowa State University faculty member from the astronomy department was then interviewed to verify the popularity of computer networking to the astronomy department (Wilson, 1989).

Also supporting this decision was the fact that in 1979, astronomy became the first discipline to organize and communicate via a discipline-based computer network ; the ARN (Astronomical Resource Network) connected all the major universities in the U.S., as well as a number of observatories and research institutions. Although the original purpose of ARN was to provide information-overloaded researchers with a data base of astronomical research information, it soon developed into a medium by which remote discipline members could communicate and a tool to disseminate "flash announcements of important phenomena, such as comets and novae" (Vallee et al., 1975, p.87). Vallee et al. also reported that ARN increased the amount of communication among astronomy members, and encouraged sharing of preliminary research reports and cooperative projects. Astronomers most appreciate access to the scientific community via computer networking when they are gone for long periods of time on earth-based or orbiting-station observation trips. In 1989, the AAS published the 1989 Electronic Mail Directory which compiled over 1,200 electronic mail addresses of AAS members. According to this directory, most astronomers in North America today use ARPA, Internet, SPAN, BITNET, UUCP, and Telenet to communicate with each other by computer networking. In addition, INFNET/ASTRONET (in Italy), JANET, EARN, ACSNET (in Australia) are used to reach international colleagues.

In order to determine the quantity of members of the astronomy discipline using computer networking, a comparison was made between the membership and electronic mail directories for the American Astronomical Society. The results of this informal observation revealed that approximately 65% of the members listed electronic mail addresses. This provided evidence that members of the astronomy discipline may vary widely in the level of computer network usage -- a necessary characteristic in this research.

Although astronomy has been studied since ancient times, and many colleges and universities offered courses in astronomy in the early and mid 1800s, the organization of astronomy teachers and researchers did not occur in the United States until the late 1800s (Sagan, 1974; Stebbins, 1947). In October of 1897, a group of astronomers and physicists met to dedicate the opening of the Yerkes Observatory in Chicago. This meeting was so successful, that a second meeting of this group was held a year later at the Harvard Observatory. Then in 1899, the Astromnomical and Astrophysical Society of America was founded in a meeting at Yerkes Observatory. One hundred and thirteen persons expressed intentions to become charter members of the society at this time. The name of the fledgling professional society -- Astromnomical and Astrophysical Society of America--was chosen in order to emphasize the fact that many physicists had interests in common with astronomers. However, fifteen years later the name was changed to the American Astronomical Society (AAS) in order to eliminate the eariy and unnecessary distinction between older astronomy and astrophysics.

The 1989 membership directory of the AAS (AAS, 1989b) reports that membership in the society is at approximately 4,800 and includes physicists, mathematicians, geologists, and engineers from the United States, Canada, and Mexico "whose research interests lie within the broad spectrum of the subject matter now comprising contemporary astronomy" (AAS, p. 9). The objective of the society is "to promote the advancement of astronomy and closely related branches of science" (AAS, p. 9). Special divisions within the society include: planetary sciences, solar physics, dynamical astronomy, high energy astrophysics, and historical astronomy.

Due to the use of a two-phase survey with several sub sections within each, it is necessary to describe the number of subjects who responded to each of the survey sections separately. The major purposes of the first section of the first phase of the survey were to collect background data, computer networking usage data, computer networking effects on faculty communication data (see Appendix A, Section I). The major purposes of the last two sections of the first phase of the survey were to determine the constructs respondents use to define their discipline (see Appendix A, Section II), and to determine the constructs respondents use to define their institutions (see Appendix A, Section III). The major purposes of the first section of the second phase of the survey were to collect computer networking usage and computer networking effects on faculty communication data (see Appendix B, Section I). The major purposes of the last two sections of the second phase of the survey were to collect data on the disciplinary culture (see Appendix B, Section II), and to collect data on the institutional culture (see Appendix B, Section III).

All respondents (N=180) completed the first section of the first phase. After completing section I of the first phase of the survey, several subjects chose not to complete sections II and/or III for various reasons; i.e., unable to see the relevance of the questions in that section to those In Section I, difficulty of questions, or unfamiliarity with the university due to the recentness of their appointment. All those who responded to any part of the first section of the first phase of the survey were sent the second phase of the survey (N=146). (The exceptions were the 7 subjects who responded to the first phase of the survey asked not to be sent the second phase.) Chi-square test results indicated that there was no significant variance in demographic features between the groups of respondents who completed all or some of the sections of the survey (see Appendix K for these chi-square tables - K.1-K.3).

Therefore, the following profile of all those who completed the first section of the first phase of the survey, provides a demographic description which can be generalized to respondents who responded to some or all of the sections of the survey. Table1.1 shows the universities where the subjects who responded to the first section of the first phase of the survey are employed. Table 1.2 indicates the experience of the subjects who responded to the first section of the first phase of the survey (see Appendix A, question I.1). Table 1.3 shows where respondents who responded to the first section of the first phase of the survey time spend the majority of their time: researching, teaching, or equally split between teaching and research (see Appendix A, question I.2).

Table 1.1 Universities where subjects of first section of first phase of survey are employed

University	N	Valid Percentage
Case Western Reserve	1	.6
Columbia University	3	1.7
Cornell University	4	2.2
Harvard University	18	10.0
Indiana University	3	1.7
New Mexico State University	2	1.1
Pennsylvania State University	11	6.1
University of Illinois	20	11.1
University of Maryland	17	9.4
University of Michigan	8	4.4
University of Minnesota	6	3.3
University of Pennsylvania	5	2.8
University of Texas	23	12.8
University of Virginia	13	7.2
University of Washington	10	5.6
University of Wisconsin	11	6.1
Yale University	9	5.0
University of Chicago	14	7.8

From Table 1.1, it is clear that a larger number of respondents are employed at Harvard University, the University of Maryland and the University of Texas whiie a smaller number represent the astronomy departments at Case Western Reserve, Indiana University, and New Mexico State University. However, these ranges in the number of respondents from each of the various universities is consistent with the size of each of the astronomy departments.

Table 1.2 Subjects' reports of experience in the astronomy discipline

Experience in the Astronomy Discipline	N	Valid Percentage
1-15 years	104	57.8
16-30 years	59	32.8
31+ years	17	9.4

According to the information in Table 1.2, the respondents of this survey have little to moderate levels of experience in being a fulltime faculty member in an astronomy department at any university.

Table 1.3 Subjects' reports of majority of time spent teaching or researching

Majority of time spent...	N	Valid Percentage
teaching	11	6.2
research	133	75
teaching and researching	33	18.6

Table 1.3 shows an overwhelming majority (75%) of the respondents of this study spend more of their time on research than on teaching or an equal mixture of the two. This is to be expected from faculty members of research universities I where research is a higher prioritized mission.

Instrumentation

The data for this research were gained from a two-phase survey (see Appendices A and B). Questions in the first sections of both phases of the survey collected data upon subjects' perception of change in their communication due to computer networking and were based upon the work of Hiltz (1984).

Questions in the last two sections of both of the phases of the survey concern changes computer networking has had upon faculty culture and used the same grounded technique as was used in Harris and Cronen (1979) and Pickett and Sorenson (1983). This grounded approach to eliciting and measuring master constructs is derived from theoretical and philosophical work such as Kelly's (1955) personal construct theory and repertory grid, Delia's (1977) ideas on the relationship between communication and constructivism, and Wacker's (1981) suggestions for assessing organizations by uncovering members' constructs of the organization. Due to the close theoretical derivation of this technique, validity and reliability measures are unknown. Neither Harris and Cronen nor Pickett and Sorenson reported validity or reliability measures. However, since the technique has yielded feasible results within the expected framework considered by these knowledgeable researchers in the field, informal reliability has been earned. In addition, since the technique is an adaptation of Kelly's repertory grid, a word about the validity and reliability of the grid may help in understanding the lack of reports of validity and reliability. Bannister and Mair (1968) reported that several studies have been conducted which show that the grid is valid

(Levy, 1956;Landfield & Nawas, 1964; Payne, 1956) and reliable (Fjeld & Landfield, 1961; Mitsos, 1958; Pederson, 1958) in according to statistical definitions, but the theoretical framework upon which the grid rests challenges the orthodox notions of validity and reliability. In essence, Bannister and Mair argued:

> Construct theory directs primary attention to superordinate and role-governing constructs, and measures of these can only be adequately validated in process and longitudinal studies. In construct theory, validation and invalidation are active procedures of the individual, and not merely ends to be achieved, or the exclusive prerogative of scientists. (p. 200)

In response to questions of the reliability of the grid technique, Bannister and Mair contend that since Kelly's personal construct theory affirms that "man is a form of motion" an effective measure should not report the same constructs each time it is used (i.e., high reliability.)

Borg and Gall (1983) noted that researchers may use measures of an unknown validity or reliability because no better measures are available; however, Borg and Gall advised that when such is the case, that such weaknesses should be pointed and out and caution should be exercised in interpreting the results and drawing conclusions. In this exploratory study such caution was used in drawing conclusions.

The first phase of the survey was divided into three sections: (I) background information and faculty communication and computer networking, (II) constructs used in building images of the discipline, and (III) constructs used in building images of the institution. In addition, a postcard response was used to clarify data from the first phase. The second phase of the survey was also divided into three sections: (I) faculty communication and computer networking, (II) perceptions of the astronomy discipline, and (III)perceptions of the institution.

Phase I

Section I of the first phase of the survey was comprised of questions I.1-I.8. The first question asked the experience level of subjects. Question I.2 asked about subjects' balance between teaching and research responsibilities. Question I.3 requested that subjects rate the frequency of various traditional and contemporary media used in communicating with their peers at different universities. If subjects did not use computer networking to communicate with their peers at different universities, they were asked to respond to question I.4 which was an open-ended question inquiring about why they do not use computer networking to communicate with their peers at different universities. Those respondents who did rank computer networking in question I.3 were asked to respond to the final four questions. Question I.5 asked subjects to report their usage level of computer networking. Subjects ranked the various computer networking functions (as reported in the literature) according to frequency of use for question I.6. Question I.7 asked subjects to identify their accessibility to computer networking. Subjects were given a chance to receive the second phase of this survey via electronic mail by indicating this wish on question I.8 and identifying their e-mail address.

The second section of the first phase of the survey asked discipline members to respond to questions designed to elicit the the constructs with which they build their image of their discipline and their institution. The following questions (which are the same as those used in Harris and Cronen's (1979) and Pickett and Sorenson's (1983) research) were asked on the survey:

1. What in your opinion makes your discipline unique among disciplines similar to it?
2. In what ways is it similar to other disciplines?
3. How would you describe your discipline when it is at its very best?
4. How would you describe your discipline when it is at its worst?

Subjects were asked to rate the importance of each of their responses defining their discipline/institution: 1= not at all important, 10=extremely important.

The third section of the first phase of the survey requested discipline members to describe the constructs with which they build their image of their institution. The above design was repeated with word "Institution" replacing "discipline".

Postcard response

Question I.5 of the first phase of the survey (see Appendix A), asked respondents to report on their level of computer networking (the independent variable). Respondents were given three choices: 1-2 times per month, 3-10 times per month, and 10+ times per month. The researcher noticed, as surveys were returned, an highly unequal number (nearly 60%) of respondents choosing the last category - "10+ times per month". In order to articulate the range of computer networking use more accurately, postcards were sent to all respondents of the first survey who selected the "10+ times per month" category for question I.5 of the first phase of the survey. The card asked an open-ended question regarding the number of times they used computer networking each month for communicating with members of the astronomy discipline at other institutions (see Appendix C).

Phase II

The second phase of the survey requested information about the subjects' perceptions of how their computer networking has affected their communication and the cultures of their discipline and institution. The first section of the second phase included questions I.1-I.4. Question I.1 asked subjects to describe their position in the conceptual mainstream of the discipline. Question I.2 asked subjects to again describe their level of computer networking. Subjects were asked in question I.3 to report their perceptions of how their use of computer networking has changed their use of other more traditional media. Likewise, in question I.4, subjects reported how their use of computer networking has changed their quantity of communication with both remote and local colleagues.

The second section of the second phase of the survey was designed to gain more information on the culture of the discipline and was constructed based on subject's responses given in Sections II and III of the first phase of the survey (see Appendix B, Section II). The responses to these open-ended questions of Sections II and III of the first phase of the survey were contextually analyzed by two independent raters. The independent judges established functionally equivalent categories from the subjects' opinions of their discipline for each of the computer networking groups. These categories represented the constructs with which subjects build an image of their discipline. The most frequently cited constructs were converted to a nine-space scale bounded by the polar adjectives. In each case, the first word of these constructs was represented by a one on a dichotomous scale and the second word was represented by a nine. (For example, if a respondent thought the discipline is very fun they would choose a 1 and if they thought it is very boring, they would choose a 9.) Respondents were asked the following questions (which are the same as those used in Harris and Cronen's (1979) and Pickett and Sorenson's (1983) research) for each of the frequently cited constructs:

1. Indicate the space that best represents what you personally believe to be the actual state of your discipline.
2. Indicate the space that best represents what you believe most others in your discipline believe to be the actual state of your discipline.
3. Indicate the space that best represents what you personally believe to be the ideal state of your discipline.
4. Indicate the space that best represents what you believe most others in your discipline believe to be the ideal state of your discipline.

The third section of the first phase of the survey requested discipline members to respond to the above same questions with word "institution" replacing "discipline".

Procedures

This section describes the instrument development, sample selection, and instrument administration.

Instrument development

The two-phase survey was developed after reviewing the literature on computer networking, faculty communication, faculty culture, and the unique features of the higher education context.

Phase I Before sending the first phase of the survey to the subjects, twenty-seven members of the astronomy discipline(from various research universities I which were not selected for the sample) were asked to review the instrument. Refer to Appendix D for a copy of the letter sent to these reviewers; some received it via traditional mail and other via e-mail. In order to determine appropriate categories by which subjects could describe their level of computer networking, each reviewer was asked to identify the three categories which would best describe the computer networking usage range within their discipline. These responses were then analyzed for commonalities. Three choices -- "1-2 times per month", "2-10 times per month", and "10+ times per month" were selected for question I.5 of the first phase of the survey. These categories provided the groupings for the subjects on the independent variable of computer networking usage. In addition, structural and word choice suggestions made by reviewers were adopted.

Phase II Before sending the second phase of the survey, members of the astronomy discipline from various research universities I not selected for the sample reviewed the instrument. Several structural and word choice suggestions were made by the reviewers. After summarizing the various reviewers' comments, the researcher modified the instrument according to these common remarks concerning clarity and design.

Sample selection

In order to determine which research universities I had astronomy departments, a 1989 AAS Membership Directory was examined. From the directory, it was determined that 24 of the research universities I had "departments of astronomy". Many of the other research universities I offered programs in astronomy within a general physics departmentor as a component of a group of specialized sciences such as MIT's "Department of Earth, Astronomy, and Planet Science" ; only those which described their departments as "departments of astronomy" were considered as a part of the population. Such departments are more likely to possess faculty members who are neither generalists or extreme specialists. Centers and institutes were not included in the population due to their less permanent and more external influences.

The sample was drawn using cluster, stratified, and systematic techniques as described in Borg and Gall (1983). The desired sample size was 345 faculty members. This number was selected based on the average expected response rates for a two-phase survey and the number of respondents needed in each of the independent variable categories. Because the methodology required comparisons of departmental members' perceptions of their common universities, departments instead of individuals were draw for the sample. Initially, each of the 24 astronomy departments was contacted to determine the size of their department by the number of faculty members. "Faculty members" was defined as all those individuals with fulltime teaching, research, or teaching and research appointments which are funded by the department. No graduate students or department chairs/heads were included in determining the size of the departments nor were they used as a part of the sample. Post doctoral, fulltime lecturers, and emeritus departmental members were included as a part of the population and sample. Departments were then classified as large (20+ members), medium (19-11 members), or small (less than 10 members). Each department was then randomly listed in each of the categories. Calculations were made to determine the number of departments needed from each of these categories in order to arrive at the necessary sample N and to represent the population proportion in the sample. The departments used in the sample were then systematically selected by dividing the population (total number of departments in each category) by the number of departments needed in the sample. Then a number smaller than the number arrived at by this division was selected. Starting at that number, every tenth department was chosen to be a member of the sample.

Administration of the survey

In order to increase response rate, the department chair/head for each of the astronomy departments of the sample and the executive officer of the American Astronomical Society (AAS) was sent a letter asking that they send a memo to each of the subjects in the sample asking them to cooperate with the survey (see Appendixes E and F) . Each department chair was contacted via telephone several days after the letters were sent to follow up on the request for support. The majority said they had or planned to send such a memo. The head of the AAS was unable to send such a memo due to a number of similar memos he had already sent to AAS members concerning support for AAS research projects.

Phase I A cover letter (see Appendix G) and the first phase of the survey (see Appendix A) was sent via conventional mail to 335 subjects at 18 universities on November 18, 1989. The cover letter detailed the purpose of the study and assured anonymity of subjects. First class postage was prepaid for the return envelope. On December 8th, memos (see Appendix H) were mailed to nonrespondents; additional copies of the survey were made available through their departmental secretaries.

The overall response rate for the first phase of the survey was 54%. Of those returning the the first phase of the survey, all 180 completed Section I, 155 completed Sections I and II, and 146 completed Sections I, II, and III. Therefore, N=180 for Section I, N=155 for Section II, and N= 146 for Section III.

Postcard Response On December 20, 1989, postcards (and a letter of explanation) where sent to the 88 subjects who selected the "10+" category to question I.5 of phase I to better articulate that response. See Appendix I for the memo which accompanied this postage paid postcard.

Phase II On January 26, 1990, 172 surveys were sent to subjects who had responded to phase I of the survey. (Seven subjects who responded to the first phase of the survey asked not to be sent the second phase.) Because the independent variable of this study was computer networking, subjects were asked on the first phase of the survey whether they would like to receive the second phase by traditional mail or electronic mail (see question I.8). 45% of the second phase surveys were sent via electronic mail and 55% were sent via traditional mail. A cover letter (see Appendix I) reviewed the purpose of the study and assured anonymity of the subjects. First class postage was prepaid for the return envelope for those sent by traditional mail. On February 15th, memos (see Appendix J) were mailed (via traditional and conventional mail) to nonrespondents; subjects were asked to contact the researcher if they need another copy of the survey.

Overall, the response rate for the second phase was 65%. The response rate for those sent by electronic mail was slightly higher (67%) than those sent by traditional mail (64%). The speed in receiving the returned surveys was much greater for electronic mail than for traditional mail; nearly half of the surveys sent via electronic mail were returned to the researcher before any of those sent via traditional mail were received. All subjects who returned the phase two completed it. Therefore N=113 for phase II responses.

Data Analysis

The data collected from the instrument described above were analyzed in several ways.

Phase I

Chi-square analyses were done on questions I.1-I.7; the comparison variable was the level of computer networking (see question I.5).

The data from sections II and III of phase I were contextually analyzed by two independent raters.

Postcard Response

The data received from the postcards were used to clarify the answer given for question I.5 of the first phase of the study. From this additional data, the categories for computer networking usage levels were changed to the following: 0-10 (low), 11-39 (medium), and 40+ (high). The data from question I.5 of phase I were re-coded to reflect this classification prior to any analyses.

Phase II

Chi-square analyses were done on questions I.1-I.4; the comparison variable was the level of computer networking (see question I.2).

The data from sections II and III were used to obtain differences in faculty cultures between the computer networking level groups. ANOVAs followed by Scheffé multiple range tests were used to determine the differences between the computer networking groups on the following components of the master contract: beliefs, ideal states, satisfaction, and feelings of sharing beliefs and ideal states. Section III of phase II was analyzed using the same statistical design. However, respondents were first grouped in the same manner as the sample was stratified: large, medium, and small departments. Originally, the study was designed to analyze each university by computer networking level groups. However, since the sample contained so few respondents in each of the cells of a computer networking level by university matrix, (i.e., University #1 low computer networking level, University #1 moderate computer networking level, University #1 high computer networking level, University #2 low computer networking level, etc.) the respondents from similar-sized departments were combined. Not only did this re-combination safeguard against statistical weakness, but protected the confidentiality of subjects.

CHAPTER IV. RESULTS

Introduction

One of the purposes of this study was to explore the effect the use of computer networking might have upon faculty members' communication. Specifically, this study explored what tasks faculty members of research universities I astronomy departments are accomplishing with computer networking. In addition, this study investigated how faculty members' use of computer networking to connect with other discipline members located at other institutions may affect their use of traditional faculty communication media and the quantity of their communication with local and distant colleagues. This research also explored the consequences such changes in faculty communication may bring to faculty disciplinary and institutional shared cultures. To do so, the study compared the way high, moderate, and low level computer networkers make master contracts with their disciplines and institutions. The components of master contract-making studied included: constructs used to define the discipline and institution, beliefs and ideal states of the discipline and institution, satisfaction with the current state of the discipline and institution, and feelings of agreeing or disagreeing on the beliefs and ideal states of the discipline and institution.

This chapter presents the results of the data collected via a two-phase mail survey as described in Chapter III. A copy of the survey instruments are available in Appendix A and Appendix B.

The results are organized according to research questions. Since each of the research questions is associated with the independent variable, computer networking usage, the first section of this chapter describes reported computer networking usage levels. Each of the tables used in this first section which are related to the independent variable of computer networking are enumerated with a "2", i.e., Table 2.4. Next, results associated with the effects of computer networking on faculty communication are presented; the first three research questions address this issue. The first research question addresses the communicative tasks accomplished by computer networking; each of the tables in this section related to communicative tasks are enumerated with a "3", i.e., Table 3.1. The second research question addresses the effects computer networking has on faculty members' use of other traditional media; each of the tables in this section related to media use are enumerated with a "4", i.e., Table 4.3. The third research question addresses the effects computer networking has on faculty members' communication with colleagues; each of the tables in this section related to media use are enumerated with a "5", i.e., Table 5.4. The final sections of this chapter present the results associated with the effects of computer networking on faculty culture; the final two research questions address this issue. The fourth research question addresses the effects computer networking has on the master contract-making with subjects' discipline; each of the tables in this section related to disciplinary master contract-making are enumerated with a "6", i.e., Table 6.5. And finally, the fifth research question addresses the effects computer networking has on the master contract-making with subjects' institutions; each of the tables in this section related to institutional master contract-making are enumerated with a "7", i.e. ,Table 7.3.

Computer Networking

The independent variable of this study was the use of computer networking by faculty members of research university I astronomy departments. Question I.5 of the first phase initially asked respondents to select one of the three categories to describe their level of computer networking used to communicate with other discipline members at other institutions ("1-2 times per month", "3-10 times per month", and "10+ times per month"). Upon early inspection of the data, it was determined that a great majority of subjects (nearly 60%) selected the last category. In order to more accurately articulate the range of this frequent response, postcards, accompanied with a letter of explanation, (see Appendix O) were sent to all subjects who had selected the "10+ times per month" response on the first phase of the survey. The postcard asked one question: "Approximately how many times per month do you use computer networking to communication with members of the astronomy discipline at other universities?" The responses to the postcards were used in determining the more balanced categories of computer networking use -- "0-10 times per month", "11-39 times per month", and "40+ times per month" -- which were used throughout this study. Table 2.1 shows the results of a chi-square analyses of level of computer networking use (as reported on the first survey and postcards) by the universities where the faculty members are employed. Table 2.2 shows the results of a chi-square analyses of level of computer networking use (as reported on the first survey and postcards) by subjects' experience in the astronomy discipline. Table 2.3 shows the results of a chi-square analyses of level of computer networking use (as reported on the first survey and postcards) by the amount of time respondents spend teaching and/or researching.

The contingency coefficient is reported to aid readers in understanding the degree of association between variables described below. However, caution should be used in comparing contingency coefficient values between tables of various sizes for the maximum possible value varies with the number of rows and columns.

From Tables 2.1-2. 3, it is clear that respondents were fairly well-distributed between the three computer networking level categories - high level users, moderate level users, and low level users. More (48%) respondents fell in the low level category than in the moderate or high level categories. In addition, chi-square tests showed no significant difference in the categories across universities, faculty experience, and teaching/research responsibilities.

Table 2.1 Level of computer networking to communicate with members of the astronomy discipline at other universities as reported on the first phase of the survey and postcards by universities

Level of computer networking	Case Number (PCT)	Columbia Number (PCT)	Cornell Number (PCT)	Harvard Number (PCT)	Indiana Number (PCT)	New Mexico State Number (PCT)	Pennsylvania State Number (PCT)	Illinois Number (PCT)
Low	1 (1.3)	2 (2.5)	0 (0)	6 (7.5)	1 (1.3)	2 (2.5)	6 (7.5)	9 (11.3)
Moderate	0 (0)	0 (0)	3 (5.3)	7 (12.3)	2 (3.5)	0 (0)	4 (7.0)	5 (8.8)
High	0 (0)	1 (3.2)	1 (3.2)	3 (9.7)	0 (0)	0 (0)	1 (3.2)	4 (12.9)
Total	1 (.6)	3 (1.8)	4 (2.4)	16 (9.5)	3 (1.8)	2 (1.2)	11 (6.5)	18 (10.7)

Table 2.1 (continued)

Level of computer networking	Maryland Number (PCT)	Michigan Number (PCT)	Minnesota Number (PCT)	Pennsylvania Number (PCT)	Texas Number (PCT)	Virginia Number (PCT)	Washington Number (PCT)
Low	9 (11.3)	3 (3.8)	2 (2.5)	5 (6.3)	13 (16.3)	5 (6.3)	4 (5.0)
Moderate	2 (3.5)	4 (7.0)	2 (3.5)	0 (0)	7 (12.3)	4 (7.0)	2 (3.5)
High	4 (12.9)	1 (3.2)	0 (0)	0 (0)	2 (6.5)	4 (12.9)	4 (12.9)
Total	15 (8.9)	8 (4.8)	4 (2.4)	5 (3.0)	22 (13.1)	13 (7.7)	10 (6.0)

Table 2.1 (continued)

Level of computer networking	Wisconsin Number (PCT)	Yale Number (PCT)	Chicago Number (PCT)	Total Number (PCT)
Low	1 (1.3)	4 (5.0)	7 (8.8)	80 (47.6)
Moderate	7 (12.3)	4 (7.0)	4 (7.0)	57 (33.9)
High	2 (6.5)	1 (3.2)	3 (9.7)	31 (18.5)
Total	10 (6.0)	9 (5.4)	14 (8.3)	168 (100.0)

Chi-square = 36.55, p=.35
Contingency Coefficient = .42

Table 2.2 Level of computer networking (as reported on the first phase of the survey and postcards) by experience in the astronomy discipline

Computer Networking Level	1-15 years Number (PCT)	16-30 years Number (PCT)	31+ years Number (PCT)	Total Number (PCT)
Low	46 (56.1)	25 (30.5)	11 (13.4)	82 (48.2)
Moderate	35 (61.4)	18 (31.6)	4 (7.0)	57 (33.5)
High	18 (58.1)	12 (38.7)	1 (3.2)	31 (18.2)
Total	99 (58.2)	55 (32.4)	16 (9.4)	170 (100)

Chi-square = 3.65, p=.46
Contingency Coefficient = .15

Table 2.3 Level of computer networking (as reported on the first phase of the survey and postcards) by how majority of time spent

Computer Networking Level	Teaching Number (PCT)	Research Number (PCT)	Teaching & Research Number (PCT)	Total Number (PCT)
Low	8 (10.0)	60 (75.0)	12 (15.0)	80 (47.6)
Moderate	1 (1.8)	41 (71.9)	15 (26.3)	57 (33.9)
High	2 (6.5)	25 (23.3)	4 (12.9)	31 (18.5)
Total	11 (6.5)	126 (75.0)	31 (18.5)	168 (100)

Chi-square = 6.60, p=.16
Contingency Coefficient = .19

Tables 2.4-2.6 indicate the results of a chi-square analyses of level of computer networking use as reported on phase II (see Appendix B, question I.2) by the universities where the faculty members are employed, their experience in the astronomy discipline, and the amount of time they spend teaching and/or researching.

The contingency coefficient is reported to aid readers in understanding the degree of association between variables described below. However, caution should be used in comparing contingency coefficient values between tables of various sizes for the maximum possible value varies with the number of rows and columns.

In addition, caution should be used in interpreting the results of the Table 2.6 ("Level of computer networking (as reported on the second phase of the survey) by how majority of time spent") for 44% of the cells of this chi-square had expected values of less than five.

Tables 2.4-2. 6 show the distribution of respondents to phase II was more balanced between the three computer networking level categories than the distribution of phase I. The moderate level group included 43 subjects and was the largest (38%) group. The low level group included 38 respondents (34%) and 32 respondents (28%) made up the high level group. In addition, chi-square tests showed no significant difference in the categories across universities and faculty experience. However, a significant difference appeared when comparing these three computer networking groups on the amount of time respondents spend in teaching or research. An inspection of the data showed that more low level computer networking users spend the majority of their time teaching than the moderate or high level users.

Table 2.7 presents the responses to question I.4 of the first phase which asked those subjects who never use computer networking why they do not used this medium.

Table 2.7 shows reasons respondents who do not use computer networking give to explain their lack of use of this medium. The most common response from this group

Table 2.4 Level of computer networking to communicate with members of the astronomy discipline at other universities as reported on the second phase of the survey by universities

Level of computer networking	Case Number (PCT)	Columbia Number (PCT)	Cornell Number (PCT)	Harvard Number (PCT)	Indiana Number (PCT)	New Mexico State Number (PCT)	Pennsylvania State Number (PCT)	Illinois Number (PCT)
Low	1 (2.6)	1 (2.6)	0 (0)	3 (7.9)	1 (2.6)	1 (2.6)	1 (2.6)	3 (7.9)
Moderate	0 (0)	1 (2.3)	1 (2.3)	5 (11.6)	1 (2.3)	0 (0)	3 (7.0)	3 (7.0)
High	0 (0)	1 (3.1)	2 (6.3)	2 (6.3)	1 (3.1)	0 (0)	1 (3.1)	5 (15.6)
Total	1 (.9)	3 (2.7)	3 (2.7)	10 (8.8)	3 (2.7)	1 (.9)	5 (4.4)	11 (9.7)

Table 2.4 (continued)

Level of computer networking	Maryland Number (PCT)	Michigan Number (PCT)	Minnesota Number (PCT)	Pennsylvania Number (PCT)	Texas Number (PCT)	Virginia Number (PCT)	Washington Number (PCT)
Low	4 (10.5)	1 (2.6)	1 (2.6)	1 (2.6)	11 (28.9)	3 (7.9)	0 (0)
Moderate	2 (4.7)	2 (4.7)	2 (4.7)	1 (2.3)	4 (9.3)	2 (4.7)	1 (2.3)
High	4 (12.5)	2 (6.3)	0 (0)	0 (0)	2 (6.3)	4 (12.5)	4 (12.5)
Total	10 (8.8)	5 (4.4)	3 (2.7)	2 (1.8)	17 (15.0)	9 (8.0)	5 (4.4)

Table 2.4 (continued)

Level of computer networking	Wisconsin Number (PCT)	Yale Number (PCT)	Chicago Number (PCT)	Total Number (PCT)
Low	2 (5.3)	2 (5.3)	2 (5.3)	38 (33.6)
Moderate	5 (11.6)	4 (9.3)	6 (14.0)	43 (38.1)
High	0 (0)	0 (0)	4 (12.5)	32 (28.3)
Total	7 (6.2)	6 (5.3)	12 (10.6)	113 (100.0)

Chi-square = 38.56, p=.27
Contingency Coefficient = .50

Table 2.5 Level of computer networking (as reported on the second phase of the survey) by experience in the astronomy discipline

Computer Networking Level	1-15 years Number (PCT)	16-30 years Number (PCT)	31+ years Number (PCT)	Total Number (PCT)
Low	23 (60.5)	9 (23.7)	6 (15.8)	38 (33.6)
Moderate	28 (65.1)	11 (25.6)	4 (9.3)	43 (35.1)
High	19 (59.4)	13 (40.6)	0 (0)	32 (28.3)
Total	70 (61.9)	33 (29.2)	10 (8.8)	113 (100)

Chi-square = 7.05, p=.13
Contingency Coefficient = .24

Table 2.6 Level of computer networking (as reported on the second phase of the survey) by how majority of time spent

Computer Networking Level	Teaching Number (PCT)	Research Number (PCT)	Teaching & Research Number (PCT)	Total Number (PCT)
Low	6 (16.7)	28 (77.8)	2 (5.6)	36 (32.4)
Moderate	0 (0)	35 (81.4)	8 (18.6)	43 (38.7)
High	2 (6.3)	24 (75.0)	6 (18.8)	32 (28.8)
Total	8 (7.2)	87 (78.4)	16 (14.4)	111 (100)

Chi-square = 10.61, p=.03
Contingency Coefficient = .30

Table 2.7 Why faculty members who never use computer networking do not use computer networking (N=14) (From question I.4 of the first phase of the survey -- see Appendix A)

Reason	N
See no advantage in using it	6
Are not connected to a network	4
Prefer the quick feedback of the telephone	2
Too lazy to learn how to do it	2
Prefer published form to ensure ideas are thought through	1
Telephone and mail more convenient and less expensive	1
Tend not to communicate regardless of the medium	1

Table 2.8 Where respondents could access computer networks (From question I.7 of the first phase of the survey -- see Appendix A)

Terminal Location	N	Valid Percentage
Either in my office, in my department or outside of my department	55	34.2
In my office	34	21.1
Either in my office or within my department	33	20.5
Only within my department	28	17.4
Either within my department or outside of my department	9	5.6
Only outside of my department	2	1.2

was that they are satisfied with the other media like the telephone and mail. Other common reasons included: lack of access and lack of motivation to learn to use this new medium.

Table 2.8 shows where users have access to computer networking (see Appendix A, question I.8). Table 2.8 indicates that respondents have little trouble finding a terminal or computer by which to access computer networking; 34% can choose to access computer networks in their offices, their departments or elsewhere on campus.

Effects of Computer Networking on Faculty Communication

One of the major purposes of this study was to explore how the use of computer networking by faculty members may affect their communication. One effect studied in this research was the communicative uses faculty members are making of this contemporary faculty medium. Also, this study explored how use of computer networking to complete various communicative tasks may affect faculty members' use of more traditional media and their quantity of communication with both remote and local colleagues.

Communicative uses of computer networking

For descriptive purposes, members of the sample astronomy departments were asked to rank a list of tasks (derived from the literature) according to the frequency they used computer networking to accomplish these tasks with members of the astronomy discipline at other institutions (see Appendix A, I.6). Because some subjects ranked all of the tasks and some ranked only three, only the top three rankings were analyzed. Table 3.1 summarizes three separate chi-square tests which were conducted on tasks which subjects ranked first, second, and third most frequently accomplished by computer networking by computer networking level. (See Tables L.1-L.3 in Appendix L for the complete results of these chi-square tests.) Since 73% of the cells of the chi-square run on the "third most frequently accomplished task" had expected values of less than five, caution should be used in interpreting these results.

An inspection of Table 3.1 reveals that the three groups show no significant difference on the most and second most frequent use of computer networking -- to share joint research project information or inferences with research partners. However, they significantly differ on the task they reported as the third most frequent use of computer networking. The low level computer networkers ranked "to prepare joint

Table 3.1 Summary of three separate chi-square tests conducted on the tasks which subjects ranked first, second, and third most frequently accomplished by computer networking with members of the astronomy discipline at other institutions by computer networking level. (From question 1.6 of the first phase of the survey -- see Appendix A)

Computer Networking Level	Most Frequently Accomplished Task	2nd Most Frequently Accomplished Task	3rd Most Frequently Accomplished Task[a]
Low	to share info. & inferences with research partners	to informally chat	to prepare joint research proposals
Moderate	to share info. & inferences with research partners	to share info & inferences with research partners	to share data & logic with research partners
High	to share info. & inferences with research partners	to share info & inferences with research partners	to gain feedback on pre-publication drafts of results

[a]According the chi-square test, the computer networking groups differ significantly on this response.

research proposals" as third most frequent use of computer networking while the moderate level computer networkers reported "to share data and logic with research partners" was the third most frequent use of computer networking. The high level computer networkers reported "to gain feedback on pre-publication drafts of results" as the third most frequent use of computer networking.

Effects of computer networking on traditional media uses

Another objective of this study was to explore how the use of computer networking by faculty members may affect their use of other more traditional media. This issue was addressed in two different ways. First, question I.3 of the first phase asked respondents to rank a list a traditional media (as derived from the literature) according to the frequency they used the medium to communicate with members of the astronomy discipline at other institutions (see Appendix A). Second, question I.3 of the second phase asked respondents to report the effect the use of computer networking has had on their use of other media to communicate with members of the astronomy discipline at other institutions (see Appendix B).

Table 4.1 summarizes three separate chi-square tests which were conducted on the media which subjects ranked first, second, and third most frequently used. Because some subjects ranked all of the tasks and some ranked only three, only the top three rankings were analyzed. (See Tables M.1-M.3 in Appendix M for the complete results of these chi-square tests.) Since 40% of the cells of the chi-square run on "most frequently used media" and 43% of the cells of the chi-square run on "second most frequently used media" had expected values of less than five, caution should be used in interpreting these results.

Table 4.1 reveals that faculty members responding to this study varied significantly on their responses to the question of media use. The chi-square analysis of the responses revealed significant differences between the three levels of computer networking on the most and second most frequently used media. An inspection of the data showed that low level computer networkers reported that the telephone and

Table 4.1 Summary of three separate chi-square tests conducted on the media which subjects ranked first, second, and third most frequently used to communicate with members of the astronomy discipline at other institutions by computer networking level. (From question I.3 of the first phase of the survey -- see Appendix A)

Computer Networking Level	Most Frequently Used Medium [a]	2nd Most Frequently Used Medium [a]	3rd Most Frequently Used Medium [a]
Low	telephone	conventional mail	conventional mail
Moderate	computer networking	telephone	conventional mail
High	computer networking	telephone	conventional mail

[a] According the chi-square test, the computer networking groups differ significantly on this response.

conventional mail was their most frequently used medium to communicate with members of the astronomy discipline at other institutions. The high and moderate level groups both reported that they use computer networking most frequently to communicate with members of the astronomy discipline at other institutions, use the telephone second most frequently, and use conventional mail third most frequently.

The next set of tables presents subjects' reports of the effects computer networking has on their use of other traditional media. Tables 4.42-4.8 indicate the impact of computer networking on the use of the telephone, conventional mail, conferences, journals and newsletters, private face-to-face meetings, preprints, and fax.

The contingency coefficient is reported to aid readers in understanding the degree of association between variables described below. However, caution should be used in comparing contingency coefficient values between tables of various sizes for the maximum possible value varies with the number of rows and columns.

The results shown in Table 4.2 indicate that 78% of the respondents reported that their use of the telephone to communicate with members of their discipline at other universities has decreased due to their use of computer networking. The results of the

Table 4.2 Subjects' reports of the effects computer networking has on their use of telephone, by level of computer networking (From question I.3a of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	3 (10.1)	8 (26.7)	19 (63.3)	30 (28.8)
Moderate	2 (4.8)	4 (9.5)	36 (85.7)	42 (40.4)
High	1 (3.1)	5 (15.6)	26 (81.3)	32 (30.8)
Total	6 (5.8)	17 (16.3)	81 (77.9)	104 (100)

Chi-square = 5.75, p=.22
Contingency Coefficient = .23

Table 4.3 Subjects' reports of the effects computer networking has on their use of conventional mail, by level of computer networking (From question I.3b of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	0 (0)	8 (27.6)	21 (72.4)	29 (28.2)
Moderate	1 (2.3)	8 (18.6)	34 (79.1)	43 (41.7)
High	0 (0)	2 (6.5)	29 (93.5)	31 (30.1)
Total	1 (1)	18 (17.5)	84 (81.6)	103 (100)

Chi-square = 6.16, p=.19
Contingency Coefficient = .24

chi-square tests showed no significant difference between each of the computer networking level groups.

The results shown in Table 4.3 indicate that 82% of the respondents reported that their use of the conventional mail to communicate with members of their discipline at other universities has decreased due to their use of computer networking. The results of the chi-square tests showed no significant difference between each of the computer networking level groups.

The results shown in Table 4.4 indicate that 91% of the respondents reported that computer networking had no effect on their use of conferences to communicate with members of their discipline at other universities. The results of the chi-square tests showed no significant difference between each of the computer networking level groups.

The results shown in Table 4.5 indicate that 89% of the respondents reported that their use of the journals and newsletters to communicate with members of their discipline at other universities has not been affected by their use of computer networking. The results of the chi-square tests showed no significant difference between each of the computer networking level groups.

The results shown in Table 4.6 indicate that 75% of the respondents reported that their use of private face-to-face meetings to communicate with members of their discipline at other universities has not been affected due to their use of computer networking. The results of the chi-square tests showed no significant difference between each of the computer networking level groups.

The results shown in Table 4.7 indicate that 91% of the respondents reported that their use of computer networking has not affected their use of preprints to communicate with members of their discipline at other universities. The results of the chi-square tests showed no significant difference between the computer networking level groups.

Table 4.4 Subjects' reports of the effects computer networking has on their use of conferences, by level of computer networking (From question I.3c of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	1 (3.4)	28 (96.6)	0 (0)	29 (28.4)
Moderate	2 (4.8)	39 (92.9)	1 (2.4)	42 (41.2)
High	1 (3.2)	26 (83.9)	4 (12.9)	31 (30.4)
Total	4 (3.9)	93 (91.2)	5 (4.9)	102 (100)

Chi-square = 6.43, p=.17
Contingency Coefficient = .24

Table 4.5 Subjects' reports of the effects computer networking has on their use of journals and newsletters, by level of computer networking (From question I.3d of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	2 (6.9)	27 (93.1)	0 (0)	29 (28.2)
Moderate	5 (11.9)	36 (85.7)	1 (2.4)	42 (40.8)
High	2 (6.3)	29 (90.6)	1 (3.1)	32 (31.1)
Total	9 (8.7)	92 (89.3)	2 (1.9)	103 (100)

Chi-square = 1.77, p=.78
Contingency Coefficient = .13

Table 4.6 Subjects' reports of the effects computer networking has on their use of private face-to-face meetings, by level of computer networking (From question I.3e of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	3 (10.3)	24 (82.8)	2 (6.9)	29 (28.4)
Moderate	1 (2.4)	33 (78.6)	8 (19.0)	42 (41.2)
High	3 (9.7)	20 (64.5)	8 (25.8)	31 (30.4)
Total	7 (6.9)	77 (75.5)	18 (17.6)	102 (100)

Chi-square = 5.97, p=.20
Contingency Coefficient = .24

Table 4.7 Subjects' reports of the effects computer networking has on their use of preprints, by level of computer networking (From question I.3f of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	2 (6.9)	27 (93.1)	0 (0)	29 (28.2)
Moderate	1 (2.4)	38 (92.9)	2 (4.8)	42 (40.8)
High	3 (9.4)	28 (87.5)	1 (3.1)	32 (31.1)
Total	6 (5.8)	94 (91.3)	3 (2.9)	103 (100)

Chi-square = 3.02, p=.55
Contingency Coefficient = .17

Table 4.8 Subjects' reports of the effects computer networking has on their use of fax, by level of computer networking (From question I.3g of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	5 (17.9)	16 (57.1)	7 (25.0)	28 (28.0)
Moderate	12 (30.0)	22 (55.0)	6 (15.0)	40 (40.0)
High	10 (31.3)	16 (50.0)	6 (18.8)	32 (32.0)
Total	27 (27.0)	54 (54.0)	19 (19.0)	100 (100)

Chi-square = 2.24, p=.69
Contingency Coefficient = .15

The results shown in Table 4.8 indicate that a slight majority (54%) of the respondents reported that their use of fax to communicate with members of their discipline at other universities has not been affected by their use of computer networking. However, 27% said that their use of computer networking has increased their use of fax while 19% reported that their use of fax has decreased due to computer networking. The results of the chi-square tests showed no significant difference between each of the computer networking level groups.

Effects of computer networking on quantity of communication with colleagues

The final research question dealing with the effect computer networking has on faculty communication concerns the impact of computer networking upon the quantity of communication with both local and remote colleagues. Two survey questions in phase II were asked to answer this research question. First, to establish a quantity communication baseline for each faculty members, question I.1 asked subjects to report where they believe they are in relation to the intellectual mainstream (see Appendix B). Question I.4 then asked each respondent to report the effects computer networking has on the astronomy faculty members' amount of communication with members of the astronomy discipline at other universities who do and do not use computer networking as well as the effect on the amount of communication with members of their own astronomy departments who do and do not use computer networking.

Table 5.1 indicates how respondents from each of the computer networking groups describe their relationship to the intellectual mainstream. (The choices to this "mainstream" question are the same ones Hiltz [1984] uses in her survey of computer network users.) Tables 5.2-5.5 show the reported effect of computer networking upon communication quantity with remote and local colleagues by computer networking groups.

The contingency coefficient is reported to aid readers in understanding the degree of association between variables described below. However, caution should be used in comparing contingency coefficient values between tables of various sizes for the maximum possible value varies with the number of rows and columns.

The results shown in Table 5.1 indicate that a majority (54%) of the respondents reported that they are "completely in the mainstream". However, the chi-square results showed that reported location in the mainstream significantly varies depending on the level of computer networking. Inspection of the data showed that moderate and high level computer networkers reported that they are more completely in the mainstream than low level users. However, because 43% of the cells of this chi-square had expected values of less than five, caution should be used in interpreting these results.

Table 5.1 Subjects' reports of their relationship to the intellectual mainstream, by level of computer networking (From question I.1 of the second phase of the survey -- see Appendix B)

Computer Networking Level	Completely in mainstream Number (PCT)	Somewhat in mainstream Number (PCT)	Neither in mainstream nor isolated Number (PCT)	Somewhat isolated Number (PCT)	Completely isolated Number (PCT)	Total Number (PCT)
Low	11 (29.7)	12 (32.4)	9 (24.3)	5 (13.5)	0 (0)	37 (33.0)
Moderate	28 (65.1)	7 (16.3)	5 (11.6)	3 (7.0)	0 (0)	43 (38.4)
High	22 (68.8)	6 (18.8)	2 (6.3)	2 (6.3)	0 (0)	32 (28.6)
Total	61 (54.5)	25 (22.3)	16 (14.3)	10 (8.9)	0 (0)	112 (100)

Chi-square = 14.41, p=.03
Contingency Coefficient = .34

Table 5.2 Subjects' reports of the effects computer networking has on their amount of communication with members of the astronomy discipline at other universities who use computer networking, by computer networking level (From question I.4a of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	22 (75.9)	7 (24.1)	0 (0)	29 (27.9)
Moderate	43 (100)	0 (0)	0 (0)	43 (41.3)
High	31 (96.9)	1 (3.1)	0 (0)	32 (30.8)
Total	96 (92.3)	8 (7.7)	0 (0)	104 (100)

Chi-square = 15.57, p=.00
Contingency Coefficient = .36

The results shown in Table 5.2 indicate that 92% of the respondents reported that computer networking has increased the quantity of communication with members of their discipline at other universities who use computer networking. The chi-square results indicated that the three computer networking level groups vary significantly on this response. Inspection of the data showed that more low level users of computer networking reported that computer networking has no effect on the quantity of communication with their remote colleagues who use computer networking than moderate or high level users. However, because 50% of the cells of this chi-square had expected values of less than five, caution should be used in interpreting these results.

The results shown in Table 5.3 indicate that 85% of the respondents reported that computer networking has not affected the quantity of communication with members of their discipline at other universities who do not use computer networking. The chi-square results showed that the three computer networking level groups vary significantly on this response. Inspection of the data showed that slightly more high level users of computer networking reported that computer networking has decreased the quantity of communication with their remote colleagues who do not use computer networking.

The results shown in Table 5.4 indicate that a slight majority (55%) of the respondents reported that their computer networking has not affected the quantity of communication with members of their astronomy department who use computer networking. However, 45% reported that communication with members of their astronomy department who use computer networking has increased due their computer networking. The chi-square tests showed no significant difference between each of the computer networking level groups.

The results shown in Table 5.5 indicate that a overwhelming majority (94%) of the respondents reported that their computer networking has not affected the quantity of

Table 5.3 Subjects' reports of the effects computer networking has on their amount of communication with members of the astronomy discipline at other universities who do not use computer networking, by computer networking level (From question I.4b of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	1 (3.4)	26 (89.7)	2 (6.9)	29 (28.2)
Moderate	2 (4.8)	38 (90.5)	2 (4.8)	42 (40.8)
High	0 (0)	24 (75.0)	8 (25.0)	32 (31.1)
Total	3 (2.9)	88 (85.4)	12 (11.7)	103 (100)

Chi-square = 9.22, p=.06
Contingency Coefficient = .29

Table 5.4 Subjects' reports of the effects computer networking has on their amount of communication with members of own astronomy department who use computer networking, by computer networking level (From question I.4c of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	16 (55.2)	13 (44.8)	0 (0)	29 (28.2)
Moderate	17 (40.5)	25 (59.5)	0 (0)	42 (40.8)
High	13 (40.6)	19 (59.4)	0 (0)	32 (31.1)
Total	46 (44.7)	56 (55.3)	0 (0)	103 (100)

Chi-square = 1.80, p=.41
Contingency Coefficient = .13

Table 5.5 Subjects' reports of the effects computer networking has on their amount of communication with members of own astronomy department who do not use computer networking, by computer networking level (From question I.4d of the second phase of the survey -- see Appendix B)

Computer Networking Level	Increased Number (PCT)	No effect Number (PCT)	Decreased Number (PCT)	Total Number (PCT)
Low	0 (0)	27 (93.1)	2 (6.9)	29 (28.4)
Moderate	0 (0)	40 (97.6)	1 (2.4)	41 (40.2)
High	0 (0)	29 (90.6)	3 (9.4)	32 (31.4)
Total	0 (0)	96 (94.1)	6 (5.9)	102 (100)

Chi-square = 1.64, p=.44
Contingency Coefficient = .13

communication with members of their astronomy department who do not use computer networking. The chi-square tests showed no significant difference between each of the computer networking level groups.

Effects of Computer Networking Faculty Culture

The second major purpose of this study was to explore the effects changes in communication induced by computer networking may have upon the shared culture of faculty members' discipline and institution. One way to assess organizational cultures is to uncover the master contract (Harris & Cronen, 1979) which guides organizational members into collective behaviors. If organizational members do not share an image of the organization, then members assign meaning to reality in differing ways and begin to act in diverse ways. Harris and Cronen theorized that master contracts include a socially constructed self-image of the collectivity including unique constructs, beliefs, and ideal states. This construction of an organizational image is achieved through organizational members' interaction. If some members of an organizational begin to interact in different ways, they may begin to share a set of constructs, beliefs, and ideal states which are different and unique from other members of the organization whose interaction does not vary in this same way. If constructs, beliefs, and ideal states become unique to subgroups they will begin to share a unique master contract which will guide them into a unique set of behaviors which may faction them from the rest of the organization.

In this study, two of the research questions being explored deal with the relationship between computer networking and faculty culture. This question emerges knowing that previous studies (Freeman & Freeman, 1980; Hiltz, 1984; Hiltz & Kerr, 1981; Hiltz & Turoff, 1978, 1985; Johansen et al., 1979; Kerr & Hiltz, 1982; Palme, 1981; Panko & Panko, 1981; Rice, 1980a; Vallee et al., 1978) have reported computer networking increases communication, and communication is the essence of culture. Since faculty members are in a unique position of maintaining simultaneous membership with both their discipline and their institution (Becher, 1987; Casanova, 1987; Clark, 1987a, 1987b; Freedman, 1979; Gregory, 1983; Kuh & Whitt, 1988; Metzger, 1987; Ruscio, 1987; Van Maanen & Barley, 1984), it was necessary to determine the effects computer networking may have on the shared cultures of both organizations.

To explore the relationship between computer networking and faculty cultures, this study investigated the effects of computer networking on faculty master contract-making with their discipline and institution; this included a comparison between the constructs, beliefs, and ideal states members of each of the computer networking level groups have of both their disciplines and institutions. To do this a two phase survey was used along with both qualitative and quantitative analyses. The first phase of the survey implemented the grounded approach of uncovering the constructs organizational members use to define their discipline and institution. This was accomplished by asking a set of open-ended questions (see Appendix A, questions II.1-II.4). The responses to these questions were contextually analyzed by independent raters into construct categories. In the second phase of the survey, the constructs which were most frequently cited in the first phase of the survey were converted into continuums with polar adjectives. Subjects were asked to rate to each construct continuum according to their own opinion and their perspective of others' opinions. The ratings were then analyzed quantitatively.

Effects of computer networking on the shared culture of the discipline

This section focuses upon the results of tests conducted to determine differences in the shared culture of the discipline among faculty members who use computer networking greatly, moderately and rarely. Shared cultured was assessed by uncovering and comparing subjects' master contracts. Master contract variance was examined first by identifying possible differences in the discipline constructs used by faculty members of each of the computer networking levels followed by an examination of beliefs and ideal states differences.

Organizational constructs An important element of the master contract is the constructs which are a cognitive means by which organizational members "determine how two phenomena are like one another and different from a third" (Harris & Cronen, 1979). Kelly (1955) described the function of constructs as "transparent templates".

Differences in discipline constructs To uncover the constructs respondents hold of their discipline and the importance they attach to each construct in defining their discipline, subjects were asked to respond to a set of open-ended questions concerning how they thought their discipline was similar and dissimilar to other disciplines and what their discipline was like at its best and worst (see Appendix A, . Section II.1-II.4). After responding to the questions, subjects were asked to rate each of their answers using a 1-10 scale (1- not at all important and 10 very important) according to the importance of each response in defining their discipline.

The responses to these open-ended questions were contextually analyzed by two independent raters. For each of the computer networking groups, independent judges established functionally equivalent categories from the subjects' descriptive data from questions II.1-II.4 of the first phase of the survey. For example, one of the subject's from the high level group responded to the question concerning how the discipline was different from other disciplines with the answer: "careful work and inferences". Both raters put this response under the "quality of research" category. Another subject from the moderate level group answered this same questions with "Astronomy is fascinating". Both raters placed this response into the "fun discipline" category. In the high level group, the judges organized 96% of all 281 elicited constructs under 14 categories by means of a card sort, with 78% agreement. In the moderate level group, the judges organized 91% of all 105 elicited constructs under 12 categories by means of a card sort, with 76% agreement. In the low level group, the judges organized 90% of all 109 elicited constructs under 13 categories by means of a card sort, with 81% agreement. The researcher then turned each of the categories which were cited by at least 5% of the computer networker groups into a dichotomous continuum. Table 6.1 shows these constructs; only these seven constructs were included in the remainder of the study. (The constructs appear on the table in the order in which they appeared on the survey II.)

A frequency of citation ranking for each construct in each group was determined by the researcher according to the percentage of subjects from each computer networking group mentioning that construct. Where ties appeared in the percentages, the construct with a higher mean rating of importance was awarded the higher rank. (See Table N.1 in Appendix N for the mean ratings of importance subjects awarded to each of

Table 6.1 Constructs Subjects Use to Define the Astronomy Discipline (Descriptive data derived from contextually analyzed responses to Questions II.1-II.4 of the first phase of the survey)

Interdisciplinary	vs.	Monodisciplinary
Scientific Based	vs.	Artistic Based
Quality Research	vs.	Weak Research
Cooperative	vs.	Uncooperative
Observation	vs.	Experimentation
Broad Scope	vs.	Narrow Scope
Fun	vs.	Boring

Table 6.2 Frequency of Citation of Constructs Subjects Use to Define the Astronomy Discipline, by Computer Networking Level Group (Ranking determined by the researcher by percentage citing that construct. Ties in percentages were ranked based on mean rating of importance. See Table N.1 in Appendix N for mean ratings of importance.)

Constructs	% Low Level Users Citing (Rank) (N=63)	% Moderate Level Users Citing (Rank) (N=48)	% High Level Users Citing (Rank) (N=29)
Interdisciplinary vs. Monodisciplinary	50.8 (3)	43.8 (2)	31.0 (5)
Scientific Based vs. Artistic Based	34.9 (4)	33.3 (5)	44.8 (2)
Quality Research vs. Weak Research	52.4 (3)	41.7 (3)	34.5 (4)
Cooperative vs. Uncooperative	22.2 (7)	37.5 (4)	44.8 (3)

Table 6.2 (Continued)

Constructs	% Low Level Users Citing (Rank) (N=63)	% Moderate Level Users Citing (Rank) (N=48)	% High Level Users Citing (Rank) (N=29)
Observation vs. Experimentation	34.9 (5)	31.3 (6)	31.0 (6)
Broad Scope vs. Narrow Scope	22.2 (6)	29.2 (7)	20.7 (7)
Fun vs. Boring	57.1 (1)	56.3 (1)	55.2 (1)

the constructs they mentioned.) Table 6.2 shows the frequency of citation of each of the seven constructs obtained from the responses to questions II.1-II.4 of the first phase of the survey

According to Table 6.2, a majority of astronomy members from each of the computer networking level groups see the astronomy discipline from the level of the excitement construct. However, the three groups vary on the frequency of citation ranking of the other constructs. The high level computer networking group varies most from the other two groups. The "interdisciplinary vs. monodisciplinary" and quality of research constructs are the next frequently cited constructs in both the low and moderate level groups while scientific based and colleague cooperation constructs are the next frequently cited for the high level group.

<u>Organizational beliefs and ideal states</u> Harris and Cronen (1979) stated that the beliefs members form about an organization, are simply "the positions assigned to the organization on crucial constructs" (p. 14). Harris and Cronen also supported Mischel's (1964) contention that organizational members also use their constructs to identify their goal states or ideal states. To discover the effects that computer networking has on

beliefs and ideal states, this study explored differences between the computer networking groups in belief and ideal states, satisfaction (difference between actual beliefs and ideal states), and feelings of holding similar beliefs and ideal states with discipline colleagues.

Differences in beliefs and ideal states of the discipline In order to explore the difference between computer networkers' beliefs toward their discipline and ideal states for their discipline, each of the most frequently cited constructs generated from the second section of the first phase of the survey was converted to a nine-space scale bounded by the polar adjectives. In each case, the first word of these constructs was represented by a one on the dichotomous scale and the second word was represented by a nine. (For example, if a respondent thought the discipline is very fun they would choose a 1 and if they thought it is very boring, they would choose a 9.) Respondents were asked to report their opinion of the actual and ideal states of the discipline on the constructs (see Appendix B, Section II).

An analysis of variance was conducted to find out if faculty members with different computer networking usage levels believe differently about the present and future state of the astronomy discipline. Borg and Gall (1983) stated that when a study is exploratory rather than confirmatory, a higher level of significance (i.e., .10) is acceptable. Results of the ANOVA on the faculty members' beliefs concerning the actual state of the discipline appear in Table 6.3. Results of the ANOVA on the faculty members' beliefs on the ideal state of the discipline appear in Table 6.4. (The constructs appear on the table in the order in which they appeared in phase II of the survey.)

From an inspection of Tables 6.3 -6.4, it appears that the three groups significantly vary on only one construct. On six of the constructs, the computer networking groups show no significant difference either on their ideas of what the astronomy discipline is

Table 6. 3 ANOVA of Beliefs of the Actual State of the Astronomy Discipline Between Computer Networking Level Groups (From section II of the second phase of the survey -- see Appendix B)

Construct	GM	SS	df	MS	F	p
Interdisciplinary (1) vs. Monodisciplinary (9)	3.73	16.73	2	8.37	2.44*	.09
Scientific Based (1) vs. Artistic Based (9)	2.32	1.15	2	.57	.33	.72
High Quality Research (1) vs. Low Quality Research (9)	2.93	3.15	2	1.58	.66	.52
Cooperative Colleagues (1) vs. Uncooperative Colleagues (9)	3.08	.37	2	.18	.08	.92
Observation Based (1) vs. Experimentation Based (9)	2.27	.05	2	.02	.02	.98
Broad Scope (1) vs. Narrow Scope (9)	2.75	.99	2	.50	.14	.87
Fun (1) vs. Boring (9)	2.15	.35	2	.18	.10	.90

*$p \leq .10$.

Table 6. 4 ANOVA of Beliefs of the Ideal State of the Astronomy Discipline Between Computer Networking Level Groups (From section II of the second phase of the survey -- see Appendix B)

Construct	GM	SS	df	MS	F	p
Interdisciplinary (1) vs. Monodisciplinary (9)	3.49	19.43	2	9.71	2.64*	.08
Scientific Based (1) vs. Artistic Based (9)	2.04	1.26	2	.63	.38	.68

*$p \leq .10$.

Table 6. 4 (Continued)

Construct	GM	SS	df	MS	F	p
High Quality Research (1) vs. Low Quality Research (9)	1.42	.01	2	.01	.01	.99
Cooperative Colleagues (1) vs. Uncooperative Colleagues (9)	1.75	2.88	2	1.44	.95	.39
Observation Based (1) vs. Experimentation Based (9)	2.78	3.18	2	1.60	.60	.55
Broad Scope (1) vs. Narrow Scope (9)	2.16	.65	2	.32	.15	.86
Fun vs. Boring	1.31	.08	2	.04	.06	.93

Table 6.5 Means and Standard Deviations of the Constructs Showing Significant Differences in Tables 6.3-6.4

Construct	Computer Networking Level	Mean	SD
(Beliefs) Interdisciplinary (1) vs. Monodisciplinary (9)	Low	3.7	1.9
	Moderate	3.4	1.7
	High	4.3	2.1
	Grand Mean	3.7	1.9
(Ideal States) Interdisciplinary (1) vs. Monodisciplinary (9)	Low	3.5	1.9
	Moderate	3.0	1.7
	High	4.1	2.3
	Grand Mean	3.5	1.9

actually like or what it should be. However, on the "interdisciplinary vs. monodisicplinary" construct, there is a difference between the three groups. According to the Scheffé tests, high and moderate level computer networkers show a significant difference in their beliefs of both the actual and ideal states of the discipline on this construct. The moderate level users see the actual state of the discipline as significantly more interdisciplinary than high level users. Likewise, the moderate level group desires a more interdisciplinary nature than those of the high level group.

Organizational satisfaction When organizational members believe that the current state of the organization is the ideal state of the organization, in essence, they are satisfied with the state of the organization. When members believe the actual and ideal states of the discipline differ, in essence, they are dissatisfied with the current state of the discipline.

Differences in satisfaction with the discipline In this study, an analysis of variance was conducted to find out if differences exist in the level of satisfaction with the current state of the discipline between faculty members with different computer networking usage levels. Respondents were asked their opinions on the actual and ideal states of the astronomy discipline on each of the shared constructs (see Appendix B, Section II). An ANOVA was use on the differences between what each group thought was the actual and the ideal states of the discipline. Results of the ANOVA on differences between own actual and ideal states of the discipline appear in Table 6.6. For this ANOVA and for each of the ANOVA on the differences conducted in this chapter, an equation was used to calculate the differences between the two variables then an ANOVA was run on these calculated differences. Borg and Gall (1983) stated that when a study is exploratory rather than confirmatory, a higher level of significance (i.e., .10) is acceptable. (The constructs appear on the table in the order in which they appeared in phase II of the survey.)

From an inspection of Table 6.6, it appears that none of the computer networking groups vary significantly on differences between the actual and ideal states of the discipline. The computer networking groups are equally satisfied and dissatisfied with the state of the discipline on the various constructs.

Table 6. 6 ANOVA of Satisfaction With the Current State of the Astronomy Discipline Between Computer Networking Level Groups (From section II of the second phase of the survey -- see Appendix B)

Construct	GM Actual	GM Ideal	S S	df	MS	F	p
Interdisciplinary (1) vs. Monodisciplinary (9)	3.73	3.49	.03	2	.02	.01	.99
Scientific Based (1) vs. Artistic Based (9)	2.32	2.04	.32	2	.16	.13	.88
High Quality Research (1) vs. Low Quality Research (9)	2.93	1.42	4.04	2	2.02	.86	.43
Cooperative Colleagues (1) vs. Uncooperative Colleagues (9)	3.08	1.75	1.00	2	.50	.23	.80
Observation Based (1) vs. Experimentation Based (9)	2.28	2.78	2.65	2	1.33	1.49	.23
Broad Scope (1) vs Narrow Scope (9)	2.75	2.16	.34	2	.17	.13	.88
Fun (1) vs. Boring (9)	2.15	1.31	.62	2	.31	.21	.81

Organization members' feelings of sharing beliefs and ideal states The difference between where organizational members think the organization is and should be and where they think their fellow organizational members think the organization is and should be, represents their feelings of sharing or failing to share beliefs and ideal states.

Differences in feelings of sharing beliefs and ideal states of the discipline In this study, analysis of variance was conducted to find out if the computer networking groups differ in their feelings of sharing beliefs and ideal states with other discipline members.

First, respondents were asked their opinions on the actual and ideal states of the astronomy discipline on each of the shared constructs (see Appendix B, Section II). Then each was asked what they thought other members of the discipline thought about the actual and ideal state of the discipline on those same constructs (see Appendix B, Section II). An ANOVA was used to analyze the differences between what each group thinks themselves and what they think others think. Results of the ANOVA on differences between own thoughts and perceptions of others' thoughts on the actual state of the discipline appear in Table 6.7; the results of the ANOVA on the ideal data appears in Table 6.9. Tables 6.8 and 6.10 show the means and standard deviations of those constructs on which the computer networking groups varied significantly for the actual and ideal data. Borg and Gall (1983) stated that when a study is exploratory rather than confirmatory, a higher level of significance (i.e., .10) is acceptable. (The constructs appear on the tables in the order in which they appeared in phase II of the survey.)

Table 6. 7 ANOVA of Feelings of Sharing Beliefs of the Astronomy Discipline Between Computer Networking Level Groups (From section II of the second phase of the survey -- see Appendix B)

Construct	GM Own Actual	GM Other Actual	S S	df	MS	F	p
Interdisciplinary (1) vs. Monodisciplinary (9)	3.73	4.46	.79	2	.39	.15	.86
Scientific Based (1) vs. Artistic Based (9)	2.32	2.15	.33	2	.17	.18	.84
High Quality Research (1) vs. Low Quality Research (9)	2.93	2.41	.14	2	.07	.07	.93

Table 6. 7 (Continued)

Construct	GM Own Actual	GM Other Actual	SS	df	MS	F	p
Cooperative Colleagues (1) vs. Uncooperative Colleagues (9)	3.08	3.09	13.00	2	6.50	5.16***	.01
Observation Based (1) vs. Experimentation Based (9)	2.28	2.29	2.65	2	1.33	1.49	.23
Broad Scope (1) vs Narrow Scope (9)	2.75	2.60	.62	2	.31	.35	.70
Fun (1) vs. Boring (9)	2.15	2.17	2.96	2	1.48	1.19	.31

***$p \leq .01$.

Table 6.8 Means and Standard Deviations of the Constructs Showing Significant Differences in Table 6.7

Construct	Computer Networking Level	What members themselves believe Actual State Mean	SD	What members think others believe Actual State Mean	SD
Cooperative Colleagues (1)	Low	3.2	1.6	3.2	1.6
vs	Moderate	3.1	1.4	3.4	1.5
Uncooperative Colleagues (9)	High	3.1	1.6	2.5	.9
	All (GM)	3.1	1.5	3.1	1.4

Table 6. 9 ANOVA of Feelings of Sharing Ideal States of the Astronomy Discipline Between Computer Networking Level Groups (From section II of the second phase of the survey -- see Appendix B)

Construct	GM Own Ideal	GM Other Ideal	SS	df	MS	F	p
Interdisciplinary (1) vs. Monodisciplinary (9)	3.49	4.15	9.32	2	4.66	1.17	.32
Scientific Based (1) vs. Artistic Based (9)	2.04	1.86	.20	2	.10	.12	.89
High Quality Research (1) vs. Low Quality Research (9)	1.42	1.33	.18	2	.09	.51	.60
Cooperative Colleagues (1) vs. Uncooperative Colleagues (9)	1.75	1.81	5.87	2	2.93	5.31***	.00
Observation Based (1) vs. Experimentation Based (9)	2.78	2.55	2.31	2	1.15	.78	.46
Broad Scope (1) vs Narrow Scope (9)	2.16	2.11	1.14	2	.57	1.82	.17
Fun (1) vs. Boring (9)	1.31	1.20	.04	2	.02	.09	.91

***$p \leq .01$.

Table 6.10 Means and Standard Deviations of the Constructs Showing Significant Differences in Table 6.9

Construct	Computer Networking Level	What members themselves believe Ideal State Mean	SD	What members think others believe Ideal State Mean	SD
Cooperative Colleagues (1 vs Uncooperative Colleagues (9)	Low	2.0	1.3	1.8	1.1
	Moderate	1.6	1.4	1.9	1.4
	High	1.6	.88	1.7	97
	All (GM)	1.7	1.2	1.8	1.2

From an inspection of the results of Tables 6.7-6.10, it appears that the computer networking groups vary significantly between feelings of shared or not shared beliefs and ideal states on only one of the constructs. According to the ANOVAs, the computer networking groups only differ on the cooperation construct. The Scheffé test showed that the high level group varies significantly from both the low and moderate level computer networkers on difference between own and other's beliefs on the actual state of this construct and moderate and low level groups differ on the ideal state. High level computer networkers think other discipline members believe the current state of the discipline to be less cooperative than they do. Low level users think that others want more cooperation in the discipline than they do.

Effects of computer networking on shared culture of the institution

This section focuses upon the results of tests conducted to determine differences in the shared culture of the institution among faculty members who use computer networking greatly, moderately and rarely. Shared culture was assessed by uncovering and comparing master contracts. Master contract variance was examined first by identifying possible differences in the institution constructs between faculty members of varying computer networking levels followed by an examination of beliefs and ideal states differences.

Because of low numbers from each of the universities, it was necessary to alter the the original design of the study which called for the comparison of responses from respondents from the same institution. The value of this sort of analysis is based on the fact that respondents were asked in the first phase of the survey to describe the constructs for their particular university and then in the second phase of the survey were asked to rate each of the constructs according to how other members of their particular department would rate them. If an accurate comparison is to be made, it is important that respondents are referring to the same organization (in this case, university). However, only a small number of representatives from each of the three computer networking groups were also employed at the same the institutions. Such a situation not only weakens the statistical analysis, but also threatens the confidentiality of the study. Therefore, based on the assumption that members of departments of similar size share beliefs on their institutions, respondents were grouped according to the size stratification of the sample. However, even with such recategorizing, the small departments were not represented well enough to be included in the statistical analysis.

Since the focus of this study ison the effect of the computer networking variable upon faculty's master contract-making, the interaction between computer networking and department size on faculty master contract-making was not analyzed. Instead, the purpose of the departmental size groupings was solely to permit more relevant comparisons between institutional images. Therefore, the following conclusions were based upon a combination of the results from large and medium-sized departments.

Differences in institutional constructs Subjects were asked to respond to a set of open-ended questions inquiring how they thought their institution was similar and dissimilar to other institutions and what their institution was like at its best and worst. This series of questions was designed to uncover the constructs subjects hold of their university and the importance they attach to each construct in defining their university (see Appendix A, questions III.2-III.4). (Due to a typographical flaw in the survey, question III.1 was confusing and thus eliminated from the data analysis. The elimination of this question did not seem to greatly effect the validity of the instrument for an inspection of the responses which were given for question III.1 described the same major constructs which were obtained by questions III.2-4. The one exception was the frequent citation of a construct describing the location of the institution.)

After responding to the open-ended questions, subjects were asked to rate each of their answers using a 1-10 scale according to the importance of each response in defining their institution. (Due to the same kind of typographical error described above, the instructions for rating each of the constructs were also confusing; therefore subjects' ratings of their responses to questions III.2-4 were also eliminated from the data analysis.)

Responses from the open-ended questions were contextually analyzed by two independent raters. For each of the computer networking groups, independent judges established functionally equivalent categories from the subjects' descriptive data from questions III.2-III.4 of the first phase of the survey. For example, one of the subject's from the low level group responded to the question concerning what the institution was like at its worst with the answer: "middle bureaucracy here can be stifling if you have to handle a personnel problem". Both raters put this response under the "management" category. Another subject from the low level group answered this same questions with "losing sense of community". Both raters placed this response into the "cooperative" category. In the high level group, the judges organized 95% of all 167 elicited constructs under 11 categories by means of a card sort, with 65% agreement. In the moderate level group, the judges organized 95% of all 65 elicited constructs under 10 categories by means of a card sort, with 78% agreement. In the low level group, the judges organized 87% of all 68 elicited constructs under 9 categories by means of a card sort, with 69% agreement. The researcher then turned each of the categories which were cited by at least 5% of the computer networker groups into a dichotomous continuum. For example, the"management" category became the "well managed - poorly managed" continuum and the "cooperative" category became the "cooperative - uncooperative" continuum. Table 7.1 shows these constructs; only these ten constructs were included in the remainder of the study. (The constructs appear on the table in the order in which they appeared on the survey II.)

Table 7.1 Constructs Subjects Use to Define Their Institution (Descriptive data derived from contextually analyzed responses to Questions III.1-III.3 of the first phase of the survey)

Adequate Support	vs.	Inadequate Support
Well Managed	vs	Poorly Managed
Progressive	vs.	Traditional
Cooperative Faculty	vs.	Uncooperative Faculty
Intelligent Students	vs.	Poor Students
Stimulating Environment	vs.	Stifling Environment
Research More Valued	vs.	Teaching More Valued
Excellent Reputation	vs.	Poor Reputation
Broad Range of Scholastic Activities	vs.	Narrow Range of Scholastic Activities
Large	vs.	Small

A frequency citation ranking for each construct in each group was determined by the researcher according to the percentage of subjects of that computer networking level group mentioning that construct. These appear in tables 7.2 and 7.3. (Since a flaw in the survey did not permit accurate results from the rating system, constructs were ranked solely on the percentage of subjects of that group mentioning that construct.) If a particular group did not mention a construct, a "0" ranking appears on the table.

According to Tables 7.2 & 7.3, respondents from each of the computer networking groups use many different constructs by which to define their institutions. In both large and medium-sized departments, the low and moderate level groups showed more similar ranks than the high level group. For example, in the large departments, the cooperation construct was the second least frequently cited construct by the low and the moderate level users while for the high level users it was the second most frequently cited.

Table 7.2 Frequency of Citation of Constructs Subjects Use to Define Their Institution, by Computer Networking Level Group from Respondents of Large-Sized Astronomy Departments (Ranking determined by the researcher by percentage citing that construct.)

Constructs	% Low Level Users Citing (Rank) (N=21)	% Moderate Level Users Citing (Rank) (N=17)	% High Level Users Citing (Rank) (N=11)
Adequate Support vs. Inadequate Support	19.0 (4)	29.4 (3)	27.3 (2)
Well Managed vs. Poorly Managed	47.6 (2)	35.3 (2)	36.3 (1)
Progressive vs. Traditional	0 (na)	23.5 (4)	18.2 (3)
Cooperative Faculty vs. Uncooperative Faculty	19.0 (4)	11.8 (6)	27.3 (2)
Intelligent Students vs. Poor Students	19.0 (4)	17.7 (5)	0 (na)
Stimulating Environment vs. Stifling Environment	0 (na)	11.8 (6)	18.2 (3)
Research More Valued vs. Teaching More Valued	28.6 (3)	41.2 (1)	18.2 (3)
Excellent Reputation vs. Poor Reputation	52.4 (1)	29.4 (3)	9.1 (4)
Broad Range of Scholastic Activities vs. Narrow Range of Scholastic Activities	14.3 (5)	11.8 (6)	9.1 (4)
Large vs. Small	9.5 (6)	5.9 (7)	9.1 (4)

Table 7.3 Frequency of Citation of Constructs Subjects Use to Define Their Institution, by Computer Networking Level Group from Respondents of Medium-Sized Astronomy Departments (Ranking determined by the researcher by percentage citing that construct.)

Constructs	% Low Level Users Citing (Rank) (N=30)	% Moderate Level Users Citing (Rank) (N=19)	% High Level Users Citing (Rank) (N=9)
Adequate Support vs. Inadequate Support	36.7 (1)	42.1 (1)	66.7 (1)
Well Managed vs. Poorly Managed	33.3 (2)	36.8 (2)	44.4 (2)
Progressive vs. Traditional	6.7 (7)	10.5 (5)	44.4 (2)
Cooperative Faculty vs. Uncooperative Faculty	23.2 (4)	10.5 (5)	33.3 (3)
Intelligent Students vs. Poor Students	6.7 (7)	10.5 (5)	0 (na)
Stimulating Environment vs. Stifling Environment	23.3 (4)	15.8 (4)	0 (na)
Research More Valued vs. Teaching More Valued	10.0 (6)	5.3 (6)	22.2 (4)
Excellent Reputation vs. Poor Reputation	6.7 (7)	10.5 (5)	0 (na)
Broad Range of Scholastic Activities vs. Narrow Range of Scholastic Activities	30.0 (3)	21.2 (3)	0 (na)
Large vs. Small	20.0 (5)	36.8 (2)	11.1 (5)

construct by the high level computer networking users and least and second least frequently cited construct by the low and moderate level users, respectfully.

In addition, the high level computer networkers used fewer constructs by which to define their institutions. It appears the high level users perceive of their institutions in more concise and homogeneous ways.

Differences in beliefs and ideal states of the institution In order to explore the difference between computer network users beliefs and ideal states of their institutions, each of the frequently cited constructs generated from the second section of the first phase of the survey was converted to a nine-space scale bounded by the polar adjectives. In each case, the first word of these constructs was represented by a one on the dichotomous scale and the second word was represented by a nine. For example, if a respondent thought their institution is very well managed they would choose a 1 and if they thought it is very poorly managed, they would choose a 9. Respondents were then asked to report their opinion of the actual and ideal states of their institution on the constructs (see Appendix B, Section III). An analysis of variance was conducted to find out if faculty members with different computer networking usage levels see the present and future state of their institution in significantly different ways. Borg and Gall (1983) stated that when a study is exploratory rather than confirmatory, a higher level of significance (i.e., .10) is acceptable. Results of the ANOVA on the actual state of the institution appear in Tables 7.4-7.5. Results of the ANOVA on the ideal state of the institution appear in Tables 7.6-7.7. Table 7.8 shows the means and standard deviation of the computer networking groups on those constructs on which they vary. (The constructs appear on the tables in the order in which they appeared in phase II of the survey.)

Tables 7.4-7.7 show significant differences between the beliefs and ideal states

Table 7.4 ANOVA of Beliefs of the Actual State of Their Institutions Between Computer Networking Level Groups from Large-Sized Astronomy Departments (From section III of the second phase of the survey -- see Appendix B)

Construct	GM	SS	df	MS	F	p
Adequate Support (1) vs. Inadequate Support (9)	4.40	2.98	2	1.49	.30	.74
Well Managed (1) vs Poorly Managed (9)	4.12	.20	2	.10	.04	.97
Progressive (1) vs Traditional (9)	4.98	6.09	2	3.05	.65	.53
Cooperative Faculty (1) vs Uncooperative Faculty (9)	4.15	18.83	2	9.41	2.76*	.07
Intelligent Students (1) vs. Poor Students (9)	3.72	23.10	2	11.55	3.58**	.03
Stimulating Environment (1) vs. Stifling Environment (9)	3.47	9.74	2	4.87	1.61	.21
Research More Valued (1) vs. Teaching More Valued (9)	2.24	.30	2	.15	.10	.90
Excellent Reputation (1) vs. Poor Reputation (9)	2.81	5.79	2	2.90	1.10	.34
Broad Range of Scholastic Activities (1) vs. Narrow Range of Scholastic Activities (9)	2.34	8.96	2	4.48	1.64	.20
Large (1) vs. Small (9)	2.59	32.19	2	16.10	4.21**	.02

*$p \leq .10$ **$p \leq .05$.

Table 7.5 ANOVA of Beliefs of the Actual State of Their Institutions Between Computer Networking Level Groups from Medium-Sized Astronomy Departments (From section III of the second phase of the survey -- see Appendix B)

Construct	GM	SS	df	MS	F	p
Adequate Support (1) vs. Inadequate Support (9)	4.50	10.65	2	5.33	1.27	.29
Well Managed (1) vs Poorly Managed (9)	4.40	11.77	2	5.85	1.31	.28
Progressive (1) vs Traditional (9)	5.25	7.64	2	3.82	.98	.38
Cooperative Faculty (1) vs Uncooperative Faculty (9)	3.80	7.43	2	3.71	.80	.46
Intelligent Students (1) vs. Poor Students (9)	3.85	8.17	2	4.09	1.46	.25
Stimulating Environment (1) vs. Stifling Environment (9)	3.44	5.33	2	2.67	1.00	.38
Research More Valued (1) vs. Teaching More Valued (9)	2.56	.70	2	.35	.22	.80
Excellent Reputation (1) vs. Poor Reputation (9)	2.67	6.36	2	3.18	1.68	.20
Broad Range of Scholastic Activities (1) vs. Narrow Range of Scholastic Activities (9)	2.00	1.73	2	.87	.52	.60
Large (1) vs. Small (9)	2.85	1.05	2	.52	.12	.88

Table 7.6 ANOVA of Beliefs of the Ideal State of Their Institutions Between Computer Networking Level Groups from Large-Sized Astronomy Departments (From section III of the second phase of the survey -- see Appendix B)

Construct	GM	SS	df	MS	F	p
Adequate Support (1) vs. Inadequate Support (9)	1.43	.56	2	.28	.29	.75
Well Managed (1) vs Poorly Managed (9)	1.21	.78	2	.19	.69	.51
Progressive (1) vs Traditional (9)	3.05	.38	2	.39	.12	.89
Cooperative Faculty (1) vs Uncooperative Faculty (9)	1.78	2.67	2	1.33	1.30	.28
Intelligent Students (1) vs. Poor Students (9)	1.43	2.84	2	1.42	1.01	.37
Stimulating Environment (1) vs. Stifling Environment (9)	1.33	1.32	2	.66	1.15	.32
Research More Valued (1) vs. Teaching More Valued (9)	3.80	2.14	2	1.07	.64	.53
Excellent Reputation (1) vs. Poor Reputation (9)	1.29	.13	2	.06	.13	.88
Broad Range of Scholastic Activities (1) vs. Narrow Range of Scholastic Activities (9)	1.40	.01	2	.01	.01	.99
Large (1) vs. Small (9)	4.14	3.76	2	1.88	.54	.59

Table 7.7 ANOVA of Beliefs of the Ideal State of Their Institutions Between Computer Networking Level Groups from Medium-Sized Astronomy Departments (From section III of the second phase of the survey -- see Appendix B)

Construct	GM	SS	df	MS	F	p
Adequate Support (1) vs. Inadequate Support (9)	1.37	2.22	2	1.11	1.36	.27
Well Managed (1) vs Poorly Managed (9)	1.08	.13	2	.06	.86	.43
Progressive (1) vs Traditional (9)	3.32	2.28	2	1.14	.51	.60
Cooperative Faculty (1) vs Uncooperative Faculty (9)	1.51	2.02	2	1.01	1.17	.32
Intelligent Students (1) vs. Poor Students (9)	1.24	.63	2	.31	1.3	.28
Stimulating Environment (1) vs. Stifling Environment (9)	1.14	.11	2	.05	.29	.75
Research More Valued (1) vs. Teaching More Valued (9)	4.08	6.37	2	3.19	2.15	.13
Excellent Reputation (1) vs. Poor Reputation (9)	1.22	.79	2	.39	.67	.52
Broad Range of Scholastic Activities (1) vs. Narrow Range of Scholastic Activities (9)	1.28	2.33	2	1.16	2.27	.12
Large (1) vs. Small (9)	3.69	5.56	2	2.78	.86	.43

Table 7.8 Means and Standard Deviations of the Constructs Showing Significant Differences in Tables 7.4-7.7

Construct	Computer Networking Level	Mean	SD
Cooperative Colleagues (1)	Low	4.0	1.7
vs	Moderate	3.6	1.9
Uncooperative Colleagues (9)	High	4.9	2.0
	All (GM)	4.2	1.9
Intelligent Students (1)	Low	4.0	2.0
vs	Moderate	2.8	1.2
Poor Students (9)	High	4.2	2.0
	All (GM)	3.7	1.9
Large (1)	Low	1.7	1.2
vs	Moderate	3.4	2.5
Small (9)	High	2.9	2.0
	All (GM)	2.6	2.1

computer networking groups have of their institutions on three of the ten constructs. A Scheffé range test showed that the moderate level computer networkers vary significantly from the high level users on the cooperation construct. Moderate level computer networkers perceive faculty members as more cooperative than the high level users do. Likewise, moderate level computer networkers think students are more qualified than the high level users do. In addition, moderate level computer networkers see their institutions as smaller than the low level users see their institutions. In summary, the moderate level computer networkers beliefs vary more from the other two groups on each of these three constructs. The moderate level users tend to see their institutions on each of the constructs in a more positive light.

Differences in satisfaction with the institution In this study, an analysis of variance was conducted to find out if differences exist in the levels of satisfaction with the current state of the institution between faculty members with different computer networking usage levels. Respondents were asked their opinions on the actual and ideal states of their institution on each of the shared constructs (see Appendix B, Section II). An ANOVA was conductd on the differences between what each group thought was the actual and the ideal states of the institution. Borg and Gall (1983) stated that when a study is exploratory rather than confirmatory, a higher level of significance (i.e., .10) is acceptable. Results of the ANOVA on differences between own thought on the actual and ideal state of the institution appear in Tables 7.9 and 7.10. Table 7.11 shows the means and the standard deviations for the computer networking groups on the constructs which were found to be significantly different in the ANOVAs. (The constructs appear on the table In the order in which they appeared in phase II the survey.)

Tables 7.9-7.10 show that the computer networking groups differ on their level of satisfaction with their institutions on three constructs. in each of the cases ofsignificance, the groups showed differences in the range between the actual and ideal states rather than differing on the direction of the ideal state. On each of the constructs which show a significant difference, the range difference is based upon the high level

computer networking group's thoughts of a less positive actual state than the other two groups and the high level group's desires to be more positive than the low and moderate level computer networking groups. Scheffé tests show that high level computer networkers differ significantly from moderate level users on the student quality construct. High level users think the current student quality is lower than what the moderate level users think and desire student quality to be higher than the moderate level users desire. Likewise, high level users differ significantly from low level computer networkers on the "stimulating environment vs. stifling environment" construct. High level users think the actual environment of their institutions is more

Table 7.9 ANOVA of Satisfaction With the Current State of of Their Institution Between Computer Networking Level Groups from Respondents of Large-Sized Astronomy Departments (From section III of the second phase of the survey -- see Appendix B)

Construct	GM Actual	GM Ideal	SS	df	MS	F	p
Adequate Support (1) vs. Inadequate Support (9)	4.40	1.43	1.31	2	.65	.14	.87
Well Managed (1) vs Poorly Managed (9)	4.12	1.21	.20	2	.10	.03	.97
Progressive (1) vs Traditional (9)	4.98	3.05	4.69	2	2.35	.47	.63
Cooperative Faculty (1) vs Uncooperative Faculty (9)	4.15	1.78	15.53	2	7.76	2.11	.13
Intelligent Students (1) vs. Poor Students (9)	3.72	1.43	31.36	2	15.68	4.98**	.01
Stimulating Environment (1) vs. Stifling Environment (9)	3.47	1.33	17.34	2	8.67	2.57*	.09
Research More Valued (1) vs. Teaching More Valued (9)	2.24	3.80	.85	2	.43	.17	.85
Excellent Reputation (1) vs. Poor Reputation (9)	2.81	1.29	7.29	2	3.64	1.35	.27
Broad Range of Scholastic Activities (1) vs. Narrow Range of Scholastic Activities (9)	2.34	1.40	8.46	2	4.23	1.71	.19
Large (1) vs. Small (9)	2.59	4.14	11.14	2	5.57	1.49	.24

*$p \leq .10$ **$p \leq .05$.

Table 7.10 ANOVA of Satisfaction With the Current State of of Their Institution Between Computer Networking Level Groups from Respondents of Medium-Sized Astronomy Departments (From section III of the second phase of the survey -- see Appendix B)

Construct	GM Actual	GM ideal	SS	df	MS	F	p
Adequate Support (1) vs. Inadequate Support (9)	4.50	1.37	21.19	2	10.59	2.49*	.09
Well Managed (1) vs Poorly Managed (9)	4.40	1.08	15.29	2	7.64	1.60	.22
Progressive (1) vs Traditional (9)	5.25	3.32	14.78	2	7.39	1.59	.22
Cooperative Faculty (1) vs Uncooperative Faculty (9)	3.80	1.51	15.29	2	7.64	1.46	.25
Intelligent Students (1) vs. Poor Students (9)	3.85	1.24	8.56	2	4.28	1.33	.28
Stimulating Environment (1) vs. Stifling Environment (9)	3.44	1.14	1.25	2	.63	.27	.76
Research More Valued (1) vs. Teaching More Valued (9)	2.56	4.08	11.01	2	5.50	1.95	.16
Excellent Reputation (1) vs. Poor Reputation (9)	2.67	1.22	2.67	2	1.33	.54	.59
Broad Range of Scholastic Activities (1) vs. Narrow Range of Scholastic Activities (9)	2.00	1.28	1.32	2	.66	.30	.75
Large (1) vs. Small (9)	2.85	3.69	1.64	2	.82	.23	.79

*p≤.10.

Table 7.11 Means and Standard Deviations of the Constructs Showing Significant Differences in Tables 7.9 and 7.10

Construct	Computer Networking Level	What members themselves believe Actual State Mean	SD	What members themselves believe Ideal State Mean	SD
(Large Departments)					
Intelligent Students (1)	Low	4.0	2.0	1.7	1.8
vs	Moderate	2.8	1.2	1.5	.8
Poor Students (9)	High	4.2	2.0	1.1	.3
	All (GM)	3.7	1.9	1.4	1.2
(Large Departments)					
Stimulating Environment (1)	Low	3.0	1.4	1.5	1.0
vs	Moderate	3.5	1.6	1.3	.7
Stifling Environment (9)	High	4.0	2.3	1.2	.4
	All (GM)	3.5	1.8	1.3	.8
(Medium-Sized Departments)					
Adequate Support (1)	Low	4.3	2.4	1.2	.4
vs	Moderate	3.9	1.7	1.7	1.3
Inadequate Support (9)	High	5.5	2.1	1.2	.6
	All (GM)	4.5	2.1	1.4	.9

stifling than the low level users think their environment is, plus the high level users desire the environment to be more exciting than the low level users desire. The high level computer networkers also vary significantly from the moderate level users on the support construct. High level users think that current support is less adequate than the moderate level users think it is and in addition, the high level users think they need more support than the moderate level users think they need.

Differences in feelings of sharing beliefs and ideal states of the institution In this study, an analysis of variance was conducted to find out if the computer networking groups differ in their feelings of sharing beliefs and ideal states with other departmental members. Respondents were asked their opinions on the actual and ideal states of the institution on each of the shared constructs (see Appendix B, Section III). Then each was asked what they thought other departmental members think about those same constructs (see Appendix B, Section III). An ANOVA was used to analyze the differences between what each group thinks of themselves and what their perceptions are of what others think. Results of the ANOVA on differences between own and other thought on the actual state of the discipline appear in Tables 7.12 and 7.13; the results of the ANOVA on the ideal data appear in Tables 7.15 and 7.16. Tables 7.14 and 7.17 show the means and standard deviations of those constructs on which the computer networking groups varied significantly for the actual and ideal data. Borg and Gall (1983) stated that when a study is exploratory rather than confirmatory, a higher level of significance (i.e., .10) is acceptable. (The constructs appear on the tables in the order in which they appeared in phase II of the survey.)

From an inspection of the results of Tables 7.12-7.17, it appears that the computer networking groups vary significantly between feelings of sharing or not sharing beliefs and ideal states their institutions on five of the ten different constructs. By examining Table 7.14, it appears there are two reasons for the groups to vary on their difference scores. In three of the cases, group members perceive that others think in the same direction on the construct as they did, but differences between the groups emerge from the width of the gap between respondents' beliefs and their perceptions of others' beliefs. For example, a Scheffé test revealed that high level computer networkers significantly varied from both moderate and low level users on the range construct. In this case the differences were due to a wider gap between the high level users' own thought and their thought of other departmental members' thoughts. All groups thought that other departmental members think that their institutions are more broad than they themselves think they are. However, the gap occurred because the high level group thinks that their institutions are more narrow than the other two groups think

Table 7.12 ANOVA of Feelings of Sharing Actual States of Their Institutions Between Computer Networking Level Groups of Respondents from Large-Sized Astronomy Departments (From section III of the second phase of the survey -- see Appendix B)

Construct	GM Own Actual	GM Other Actua	SS	df	MS	F	p
Adequate Support (1) vs. Inadequate Support (9)	4.40	4.77	6.06	2	3.03	1.57	.23
Well Managed (1) vs Poorly Managed (9)	4.12	4.42	3.91	2	1.96	1.36	.26
Progressive (1) vs Traditional (9)	4.98	5.13	9.26	2	4.63	2.16	.13
Cooperative Faculty (1) vs Uncooperative Faculty (9)	4.15	3.78	4.67	2	2.34	1.28	.29
Intelligent Students (1) vs. Poor Students (9)	3.72	3.80	2.45	2	1.22	2.00	.15
Stimulating Environment (1) vs. Stifling Environment (9)	3.47	3.09	13.92	2	6.96	5.42***	.00
Research More Valued (1) vs. Teaching More Valued (9)	2.24	2.41	.57	2	.29	.39	.68
Excellent Reputation (1) vs. Poor Reputation (9)	2.81	2.51	38	2	.19	.22	.80
Broad Range of Scholastic Activities (1) vs. Narrow Range of Scholastic Activities (9)	2.35	2.00	6.04	2	3.02	4.35**	.02
Large (1) vs. Small (9)	2.59	2.60	.35	2	.17	.82	.45

**$p \leq .05$ ***$p \leq .01$.

Table 7.13 ANOVA of Feelings of Sharing Actual States of Their Institutions Between Computer Networking Level Groups of Respondents from Medium-Sized Astronomy Departments (From section III of the second phase of the survey -- see Appendix B)

Construct	GM Own Actual	GM Other Actual	S S	df	MS	F	p
Adequate Support (1) vs. Inadequate Support (9)	4.50	5.31	13.06	2	6.53	2.09	.14
Well Managed (1) vs Poorly Managed (9)	4.40	5.18	12.67	2	6.33	1.76	.19
Progressive (1) vs Traditional (9)	5.25	5.38	1.74	2	.87	.43	.65
Cooperative Faculty (1) vs Uncooperative Faculty (9)	3.80	3.54	1.71	2	.85	.79	.46
Intelligent Students (1) vs. Poor Students (9)	3.85	4.31	6.54	2	3.27	1.92	.16
Stimulating Environment (1) vs. Stifling Environment (9)	3.44	3.72	13.94	2	6.97	5.57***	.00
Research More Valued (1) vs. Teaching More Valued (9)	2.56	2.87	23	2	.12	.09	.92
Excellent Reputation (1) vs. Poor Reputation (9)	2.67	2.36	6.92	2	3.46	5.89***	.00
Broad Range of Scholastic Activities (1) vs. Narrow Range of Scholastic Activities (9)	2.00	2.14	93	2	.46	.67	.52
Large (1) vs. Small (9)	2.85	2.65	1.08	2	.54	1.90	.16

***$p \leq .01$.

Table 7.14 Means and Standard Deviations of the Constructs Showing Significant Differences in Tables 7.12 and 7.13

Construct	Computer Networking Level	What members themselves believe Actual State Mean	SD	What members think others believe Actual State Mean	SD
(Large Departments)					
Stimulating Environment (1)	Low	3.0	1.4	3.2	1.4
vs	Moderate	3.5	1.6	3.1	1.4
Stifling Environment (9)	High	4.0	2.3	2.9	2.0
	All (GM)	3.5	1.8	3.1	1.6
(Medium-Sized Departments)					
Stimulating Environment (1)	Low	4.1	2.0	3.3	1.3
vs	Moderate	3.3	.7	4.0	2.0
Stifling Environment (9)	High	3.2	1.3	3.6	1.4
	All (GM)	3.4	1.6	3.7	1.7
(Medium-Sized Departments)					
Excellent Reputation (1)	Low	2.8	1.9	2.1	1.2
vs	Moderate	2.3	1.0	2.4	1.1
Poor Reputation (9)	High	3.3	1.5	2.5	1.1
	All (GM	2.7	1.4	2.4	1.1
(Large Departments)					
Broad Range of					
Scholastic Activities (1)	Low	2.0	1.2	1.9	1.1
vs	Moderate	2.2	1.7	2.1	1.5
Narrow Range of	High	2.9	2.1	2.1	1.3
Scholastic Activities (9)	All (GM)	2.3	1.7	2.0	1.3

their institutions are.

The other reason why the groups showed variance in their difference scores is the lack of similar direction on the construct. Most of the groups differed due to this reason. High level users from the large astronomy departments significantly varied from the low level users because the high level users think others think their institution is more exciting than they think it is while the low level users think other departmental members

Table 7.15 ANOVA of Feelings of Sharing Ideal States of Their Institutions Between Computer Networking Level Groups of Respondents from Large-Sized Astronomy Departments (From section III of the second phase of the survey -- see Appendix B)

Construct	GM Own Ideal	GM Other Ideal	S S	df	MS	F	p
Adequate Support (1) vs. Inadequate Support (9)	1.43	1.22	59	2	.29	.50	.61
Well Managed (1) vs Poorly Managed (9)	1.21	1.25	.25	2	.12	.28	.76
Progressive (1) vs Traditional (9)	3.05	3.33	71	2	.35	.17	.84
Cooperative Faculty (1) vs Uncooperative Faculty (9)	1.78	1.97	3.44	2	1.72	2.77*	.07
Intelligent Students (1) vs. Poor Students (9)	1.43	1.38	.38	2	.19	.64	.53
Stimulating Environment (1) vs. Stifling Environment (9)	1.33	1.26	44	2	.22	2.23	.12
Research More Valued (1) vs. Teaching More Valued (9)	3.80	3.25	.78	2	.39	.22	.80
Excellent Reputation (1) vs. Poor Reputation (9)	1.29	1.17	01	2	.01	.05	.95
Broad Range of Scholastic Activities (1) vs. Narrow Range of Scholastic Activities (9)	1.40	1.34	15	2	.08	.16	.85
Large (1) vs. Small (9)	4.14	3.69	4.28	2	2.14	1.37	.26

*$p \leq .10$.

Table 7.16 ANOVA of Feelings of Sharing Ideal States of Their Institutions Between Computer Networking Level Groups of Respondents from Medium-Sized Astronomy Departments (From section III of the second phase of the survey -- see Appendix B)

Construct	GM Own Ideal	GM Other ideal	S S	df	MS	F	p
Adequate Support (1) vs. Inadequate Support (9)	1.37	1.21	.80	2	.40	.98	.39
Well Managed (1) vs Poorly Managed (9)	1.08	1.05	.04	2	.02	.76	.48
Progressive (1) vs Traditional (9)	3.32	3.19	1.96	2	.98	.35	.71
Cooperative Faculty (1) vs Uncooperative Faculty (9)	1.51	1.61	3.21	2	1.60	1.43	.25
Intelligent Students (1) vs. Poor Students (9)	1.24	1.17	15	2	.08	.95	.40
Stimulating Environment (1) vs. Stifling Environment (9)	1.14	1.20	57	2	.28	.98	.39
Research More Valued (1) vs. Teaching More Valued (9)	4.08	3.49	6.34	2	3.17	2.81*	.08
Excellent Reputation (1) vs. Poor Reputation (9)	1.22	1.09	1.37	2	.68	1.47	.25
Broad Range of Scholastic Activities (1) vs. Narrow Range of Scholastic Activities (9)	1.28	1.18	16	2	.08	1.37	.27
Large (1) vs. Small (9)	3.69	3.12	16	2	.08	.05	.96

*$p \leq .10$.

Table 7.17 Means and Standard Deviations of the Constructs Showing Significant Differences in Tables 7.15 and 7.16

Construct	Computer Networking Level	What members themselves believe Ideal State Mean	SD	What members think others believe Ideal State Mean	SD
(Large Departments)					
Cooperative Faculty (1)	Low	2.0	1.0	2.0	.9
vs	Moderate	1.5	.9	1.9	1.2
Uncooperative Faculty (9)	High	1.8	1.1	2.0	1.5
	All (GM)	1.8	1.0	2.0	1.2
(Medium-Sized Departments)					
Research More Valued (1)	Low	4.6	.7	3.3	1.7
vs	Moderate	4.3	1.4	3.7	1.2
Teaching More Valued (9)	High	3.5	1.2	3.4	1.0
	All (GM)	4.1	1.3	3.5	1.3

think their institution is more stifling than they think it is. Contrastingly, the low level computer networkers from the medium-sized astronomy departments vary from both the moderate and high level users for they think other departmental members think their institution is more exciting than they think it is while the moderate and high level users think others think it is more stifling than they think it is. On the reputation construct moderate level users vary from both the high and low level computer networkers for they think other departmental members think their institution has a worse reputation than they think it does while the low and moderate level users think other departmental members think their institution has a better reputation than they think it has.

Table 7.17 shows that the computer networking groups also varied significantly on two of the ideal state constructs due to directional differences and a gap between own and others' ideal states. Moderate level computer networkers significantly differed from low level users on the cooperation construct for they think that other departmental members want their institution to be less cooperation than they want it to be whiie lower level computer networkers think that others desire the same amount of cooperation within their institution as they do. On the reputation construct, high level users varied significantly from low level users for high level computer networkers. High level computer networkers think that other departmental members desire their institution to value research at nearly the same level as they do; the low level computer networkers think that other departmental members want their institution to value research more than they desire it to be valued.

In summary, the computer networking groups vary greatly in their feelings of sharing or not sharing beliefs and ideal states. Each of the significant differences occurred on different constructs and in most cases the cause of the difference was a variance in the direction between own and other's beliefs and ideals. The groups showed less variance on the ideal states than the actual states.

CHAPTER V. DISCUSSION

Introduction

The purpose of this chapter is to interpret the results which were reported in the previous chapter. The independent variable of computer networking is discussed first, followed by a discussion of how the data can be used to answer each of the research questions. The first three research questions deal with the effects computer networking has upon faculty communication (tasks accomplished, changes in use of other media, and changes in quantity of communication with remote and local peers). The last two research questions deal with effects computer networking has upon disciplinary and institutional shared cultures.

Computer Networking

The independent variable in this study was computer networking. Although it was somewhat difficult to measure this variable, the amount of use varied greatly among this group of members of astronomy departments at research universities I. Of the 180 subjects who responded to the first phase of the survey, 14 (8%) reported having never used computer networking while 5 reported that they use computer networking as much as 300 times per month. Such a wide range of use may be explained from several points of view.

First, the measurement of the variable may not have been precise enough to provide an accurate profile of the level of use. Respondents were asked to provide a self-report on this variable via the questions, "How often do you use computer networking to communicate with members of the astronomy discipline at other institutions?" In general, self-reports may vary from reality due to forgetfulness or attempts to glamorize reality. More specifically, although this question asked respondents to recall their frequency of use of computer networking, some may have unintentionally reported the length rather than the number of times (frequency) of communication with colleagues.

Also, the question uses the somewhat general phase "to communicate" in order to capture a wide range of the subjects' communicative behaviors. In answering this question, some respondents may have recalled only one-to-one "conversations" with peers while others more broadly defined the phase to mean an exchange of a data set or the use of a remote computer or telescope. In looking at the tasks that subjects reported accomplishing via computer networking, subjects reported more frequent use of those functions which are more "conversational" and less frequent use of computer networking to access remote equipment and data bases. From this, it appears that many subjects may have more narrowly defined "to communicate" as a conversation with peers. Therefore, the level of computer networking usage between universities (which would include conversational activities as well as access of remote resources) is possibly higher than that reported in this study.

Apparently usage levels vary over time also. Anecdotal comments on the survey described the timing contingency in responding accurately to this question regarding computer networking use. Subjects stated that their level of use depends on the point in their research or the nearness of conference dates. Also, 10% of the those who responded to the second phase of the survey reported a different level of usage than they reported on the first phaseof the survey; the first phaseof the survey was sent in late November and the second phase of the survey was sent in late January. Such differences in levels of use may be explained by the various levels of communication necessary in the research process. Garvey and Griffith (1971) stated that researchers use more informal communication in the early phases of a research project in order to receive valuable feedback used to modify their work. In later phases of a research project, researchers use more formalized communication like conferences and journal publication to disseminate their finalized reports. However, Garvey and Griffith argued that some informal communication occurs in order to prepare for the peer-sponsored conferences. Such communication may be needed to make logistical plans for the upcoming conference. In other cases some researchers (especially younger ones) use the time between when a conference program is published and several weeks after the conference to attempt to connect with other researchers with similar interests and research projects in order to build or join an informal network or invisible college. Therefore, perhaps the varying reported rates in computer networking levels reflect the increases and decreases of informal communication between researchers at different places in the research process. If this is true, then this is another good indication of the importance of computer networking as a dominant medium in traditional faculty research communication. Future research needs to explore the relationship between phases of the research process and computer networking.

The common reasons given for not using computer networking to communicate with colleagues at other universities included: no advantage to using it , not connected to a network, telephone allows for quicker interactive feedback, and too lazy to learn about it. It is interesting to note that while Table 2.8 shows that respondents report that access to computer networking is very easy, 29% of respondents who have never used computer networking explain that the reason they do not is because of unavailable access. Perhaps, this is a sign of ineffective communication within departments.

Effects of Computer Networking on Faculty Communication

The first three research questions asked respondents to report how computer networking affects their communication. The first question asked what communicative tasks they are now accomplishing using this new medium. The second question addressed the effects their use of computer networking has on the use of other media. The third question asked about the effects of computer networking on the amount of communication with both remote and local colleagues.

Communicative uses of computer networking

The respondents reported that they use computer networking most to communicate with remote research team members. As evidenced in Table 3.1, all computer networking groups ranked "to share joint research project information or inferences with research partners" as the most frequently accomplished task by computer networking with members of the astronomy discipline at other institutions. Both high and moderate level computer networkers also ranked this same task the second most frequently accomplished by computer networking. In addition, the moderate level users ranked "to share data sets or logic" as the third most frequently accomplished task accomplished by computer networking and the low level users ranked "to prepare joint research proposals" as the third most frequently accomplished task by computer networking. Perhaps this begins to explain one of the reasons computer networking is so popular in a hard science discipline like astronomy. Becher (1987) stated that the hard sciences teach their graduate students to work in teams and then this carries over into their post graduate faculty positions. The nature of this type of discipline is to dissect and assign the known and agreed upon research problems to various teams. However, as Clark (1987b,1984) and Ruscio, (1987) stated, the structure of higher education in the United States, relocates these potential team members to various universities. In order to continue the mission of the discipline's research agenda, members must use some efficient medium to connect themselves. Computer networking facilitates this research requirement.

Specifically, the medium is even more valuable for members of the astronomy discipline who need to travel to remote observing sites yet also need to keep connected with colleagues. Several of the subjects who returned their surveys late via conventional mail apologized for the lateness but explained that they had been "out observing". Several who responded via electronic mail noted that they would be observing when the second phase arrived, but that they would check their electronic mailboxes for it from their observation sites.

Respondents also reported that they use computer networking to informally communicate with remote colleagues. "To informally chat" was the second most frequently accomplished task via computer networking by moderate level computer networkers. In addition, "to gain feedback on pre-publication drafts of research results" was ranked third most frequently accomplished task via computer networking by high level computer networkers. According to Garvey and Griffith (1971) these communicative acts are the heart of informal communication networks or invisible colleges. Researchers need to test their initial ideas, methodologies, and conclusions with a group of interested and trusted peers prior to publication or conference submission. Although it is uncertain as to the exact purpose of the "informal chats", by placing this option at the end of the possible responses to the question (see Appendix A, question I.6), it was assumed that such chats would be about something other than the functions listed above it. In informal chatting, discipline members share personal information which allows or disallows them to build trusting colleague relationships. These sorts of relationships are the foundation of invisible colleges (Becher, 1987; Clark, 1980; Crane, 1972; Griffith & Mullins, 1972; Price, 1963).

Interestingly, although much of the literature discussed the advantage of using computer networking to speed (Aspen Systems Corp.,1974; Berul & Krevitt, 1974) or bypass (DeLoughry, 1989) the publication process, the respondents did not rank "to disseminate final research results" as an important function they accomplish via computer networking. Vallee et al. (1975) reported that ARN (Astronomical Resource Network) has available a staff of editors to review and edit both preliminary and final research results submitted by astronomy faculty members. Vallee et al. also reported that faculty members were being professionally rewarded for such electronic publication and that two astronomy journals were "discontinued because the network performs this function so effectively" (p. 89). However, the results from this study indicated that computer networking is rarely used for final research results. Perhaps since Berul and Krevitt , Aspen Systems Corp., and Vallee et al. are writing at nearly the same time computer networks are being developed, their work is more speculative than descriptive.

Effects of computer networking on traditional media uses

In order to understand faculty members' use of various media to communicate with colleagues at different universities, the first phase of the survey asked respondents to rank a list of commonly used faculty media according the frequency of their use. The results showed that respondents of the high and moderate levels of computer networking ranked computer networking first, telephone second and conventional mail third. Low level computer networkers ranked telephone first, conventional mail second and conferences third. As mentioned in Chapter Four, since a high percentage of the cells of the chi-square had expected values of less than 5, caution should be used in interpreting these results. However, in inspecting the actual numbers in the chi-square, it is clear that there is a difference between how the heavier users of computer networking and the low level users rank various media. The fact that some respondents who have never used computer networking were placed in this lower category ("0-10 times per month") may explain some of this variance.

Understanding that computer networking is as or more important to these faculty members as the telephone and conventional mail, and also knowing that faculty members are using computer networking to link with research partners and members of their invisible colleges, the next question to ask is how has the use of computer networking affected the use of these and other traditional media. A large majority (78% and 81% respectively) of respondents reported that their telephone and conventional mail use has decreased because of computer networking. It is important to note that these media and computer networking make up what subjects reported as the top three most frequently used faculty media. The decrease was reported consistently across all three levels of computer networking use. Respondents overwhelmingly agreed that the other media has not been affected by their use of computer networking. The only exception to this strong agreement across all computer networking groups was the effect computer networking has on fax use. While the majority (54%) agreed that there had been no effect on their use of fax due to their computer networking, the remaining respondents were fairly well split between their reports of increased and decreased effects.

These findings support the ideas of scholars who predicted that computer networking would replace more traditional faculty media (Catlett, 1989; Compton, 1987; Francas & Larimer, 1984; Hiitz, 1984; Komsky, 1988b; May, 1985; Hiltz & Turoff, 1978; Vallee & Johansen,1974) as well as those who argued that computer networking would not affect traditional faculty communication media (Hiltz, 1984; Hiltz & Turoff, 1978; Ratcliff, 1984; Vallee et al., 1974). The contingent factor in determining whether computer networking will effect another media seems to be based on a simple competitive notion - the best medium wins. The criteria of the competition are the ability of various media to accomplish the various communicative tasks of faculty members. The results from this study indicate that computer networking is best fitted to accomplish quick interactive exchanges of simple or complicated data (i.e., logic exchange) in written format. Both the telephone and conventional mail attempt to accomplish part of these same tasks. However, the reports of decreases in the use of the telephone and conventional mail due to computer networking seemed to indicate that computer networking is accomplishing these communicative tasks more effectively, efficiently, and completely.

Contrastingly, computer networking is not effecting other media such as conferences, journals and newsletters, face to face meetings, and preprints. Apparently, these media accomplish some communicative task better than computer networking can. Freeman and Freeman (1980) found that initial meetings are very important in developing working relationships which can then grow via computer networking. Perhaps computer networking's lack of "social presence" (Short et al., 1976; Vallee et al. ,1974) makes it less effective in accomplishing the communicative task of initializing relationships. Instead, conferences and face-to-face meetings accomplish this task more effectively. Likewise, although computer networks can disseminate research results such as journals do, they can not allocate recognition and reward to faculty members (De Mey, 1982; Garvey & Griffith, 1971; Ratcliff, 1984; Raymond, 1989). Therefore, it seems that faculty members continue to use journals to disseminate final results to researchers outside of the interest area and to gain recognition and reward and save the use of computer networking for the communicative tasks it accomplishes best -- collaboration. This explains why scholars like DeLoughry (1989) speculated on the value of electronic publication, while very little is actually done.

More research needs to be done investigating computer networking's and other technologies' relationship to the role change traditional media experience. Garvey and Griffith (1971) stated that journals were formally used for collaboration but now are used for second-rate dissemination and prestige tasks. Do such traditional media take on new roles after losing the race to more effective media or do they elevate previously minor roles?

Finally, since the fax and computer networking are very similar in their abilities, it is surprising to find more respondents do not believe that facsimile machines decrease their use of computer networking. This may be explained by a lack of access to facsimile equipment. Those respondents who reported an increase in use of the fax machine due to their use of computer networking may be experiencing the type of increase Hiltz (1984) describes as the "expansion effect". Hiltz predicted that computer networking might not only complement traditional media but might stimulate more communication via all media. Such an explanation is contingent upon which of the media they adopted first. If faculty began utilizing computer networking prior to using the fax machine (which is most probably do the age of each technology), they may have increased their repertoire of contacts which increased their need to communicate with more colleagues. They may have grown accustomed to the features of computer networking such as the speed of written information exchange. However, they may not have had time to enter the information into the computer nor have access to a optical scanner. Therefore, they may turn to the fax machine.

Effects of computer networking on quantity of communication with colleagues

In order to determine the communicative nature of the respondents, the second phase of the survey asked subjects to describe themselves in relation to the intellectual mainstream of the discipline. Hiltz (1984) found that such a description provided a good indication of normal communication levels of faculty members. From this point of reference, the effect of a change in the amount of communication due to computer networking could be better understood. The results showed that most respondents from all of the groups described themselves as involved in the mainstream of the discipline. This is partially due to the fact that members of the sample were drawn from research universities I. Faculty members at such universities are generally leaders in the research field.

The slight variance between the two higher level computer networking groups and the low level users in their perception of their place in the mainstream may be caused by the intervening variable of "experience in the discipline". Nearly an equal amount of low level computer networkers reported themselves as fully in mainstream as those who described themselves "somewhat in mainstream". Slightly more respondents from the low level category are inexperienced and thus may not yet be as far into the mainstream as they desire. Or perhaps the tendency of faculty members who see themselves as more a part of the mainstream need to use computer networking frequently to keep abreast of mainstream thought.

Computer networking has affected the amount of communication faculty members have with both remote and local peers. Overwhelming majorities from each of the groups reported that communication quantity has increased with peers from other universities who are using computer networking. In essence, these findings are consistent many studies (Freeman & Freeman, 1980; Hiltz, 1984; Hiltz & Kerr, 1981; Hiltz & Turoff, 1978, 1985; Johansen et al., 1979; Kerr & Hiltz, 1982; Palme, 1981; Panko & Panko, 1981; Rice, 1980a; Vallee et al., 1978) which have found that computer networking does increase connectiveness. More members of the lower level group reported no effect on the amount of communication with remote colleagues due to computer networking. This could be due to the number of faculty members in this group who never use computer networking or are inexperienced and/or tangentially related to the mainstream. In addition, perhaps there is a level of usage which one must reach before feeling a substantial change in communication quantity.

Future research needs to investigate specifically the effect computer networking has upon connectivity. Does computer networking increase connectivity size (increase in number of links) or connectivity density (increase in quantity of communication between the same number of links)? If it only increases connectivity size, computer networkers will tend to become a more heterogeneous group. If it only increases density, computer networkers will tend to become a more homogeneous group.

A large majority of respondents from each of the groups believed that their computer networking had no effect on the amount of communication between themselves and other members of their departments who did not use computer networking. These results run contrary to Hiltz (1984) findings. Hiitz found that a minority of users reported an increase in communication with noncomputer networking peers. She explained that this increase may be due to the computer networkers' opportunity to be informational liaisons for their non-user peers.

Although a slight majority from all groups reported that their computer networking had no effect on communication with computer networkers within their own department, a large minority from each of the groups stated that computer networking had increased communication with their departmental members who use computer networking. Perhaps Hiltz's (1984) informational liaison concept can also be applied to this situation. Computer networking increases communication with others from various institutions thereby potentially increasing the information and perceptual intake of the computer networker. Such increased information and perspectives may motivate mutual exchange with local colleagues who have also gained new insights from their computer networking.

Effects of Computer Networking on Faculty Culture

Although overall, the study revealed that computer networking showed only a few significant effects on faculty members' shared cultures of their discipline and institutions. The minor effects which appeared varied by the component of master contract being investigated, the culture being studied, and the construct being examined.

Overall lack of effect

Of the 85 statistical comparisons made between the computer networking groups on the master contract they hold of their discipline and institution, only 16 showed a significant difference. (These numbers do not include the descriptive statistics which were reported on the differences in constructs.) Not only was the quantity of the differences sparse, but their statistical strength was also somewhat weak. Seven of the significant differences were at the $p \leq .10$ level, four were at the $p \leq .05$ level, and five were at the $p \leq .01$ level. In all, the computer networking groups appear to be more similar than they are different on the master contract they make with both their discipline and institutions. Computer networking use does not appear to effect disciplinary or institutional shared cultures.

One explanation for these results could be that the type of message exchange between computer networkers does not include all of the elements necessary for culture or master contract building and maintaining. Hall said that (1959): "Culture is communication and communication is culture" (p. 191). Cushman (1977) and Pacanowsky and O'Donnell-Trujillo (1982) perceived culture as the "consequence" and "residue" (respectively) of the communication process. Schall (1983) argued that such culture-creating communication includes

> ...meaningful symbolic transactions through verbalizations, vocalizations (nonword sounds, as well as rate, pitch, and tone), and nonverbal behaviors or cues (e.g., gestures, appearance, furnishing, spatial relationships, posture, etc.).... Cultures, then, are created, sustained, transmitted, and changed through social interaction -- through modelling and imitation, instruction, correction, negotiation, story-telling, gossip, remediation, confrontation, and observation -- all activities based on message exchange and meaning assignment, that is, on communication (pp. 559-

560).

In essence, Schall pointed out that all communication, not just verbal exchange is an important part of the culture-making process. Cheney and Tompkins (1987) also note the importance of nonverbal message exchange in culture building and maintaining. Perhaps then one reason computer networking is not greatly affecting the master contract-making process is due to its narrow bandwidth (Furgeson, 1977; Hiemstra, 1982; Hiltz & Turoff, 1978; Krueger & Chapanis, 1980; Johansen & DeGrasse, 1979; Lin, 1987; Rogers, 1986; Spelt, 1977; Vallee & Johansen, 1974). Such a narrowband width only allows for verbal exchange and minimal parallnguistic message exchange. Unlike the face-to-face communication between faculty members at conferences or on observation meetings, communication via computer networking allows for limited message exchange and thus limited culture or master contract-building. Work like Carey's (1980) which investigates the the unique parallnguistic features users adapt within this limited bandwidth medium (i.e., spacing for speed of delivery, extra punctuation for tonal cues, etc.) need to be continued in order to understand more fully the unique nonverbal messages which computer networkers exchange and which may affect culture and master contract making.

Another explanation for the limited effect of computer networking on culture or master contract-making could be that the communication between computer networkers rarely includes the type of content which builds master contracts. Deal and Kennedy (1982) explained that the values upon which organizational cultures are based are communicated most effectively by rites and rituals. Rituals are to the organizational culture "what the movie is to the script or what the concert is to the score..." (p. 63). In essence, rites and rituals are dramatizations of the organization's basic values and provide "the place and the script" (p. 62) with which organizational members can make sense of reality. The master contract is the set of beliefs or values upon which organizational members agree. If Deal and Kennedy are correct, one of the most effective ways of master contract-making is the use of rites and rituals.

The ability of computer networking to transfer rites and rituals is limited. Rites and rituals are subjective exchanges while most computer networking exchange is objective interaction. Researchers agree that the content of most computer networking messages is business-like (Furgeson, 1977; Hiemstra, 1982; Hiltz & Turoff, 1978; Krueger & Chapanis, 1980; Johansen & DeGrasse, 1979; Lin, 1987; Rogers, 1986; Spelt, 1977; Vallee & Johansen, 1974). The results of this study also showed that faculty members most frequently use computer networking for information exchange. In addition, others who have studied the uses of computer networking among higher education researchers also have found that researchers usually use computer networking for task-oriented communication (Barden & Golden, 1986; Fuchs, 1983; Greenberger et al., 1974; Hiltz & Turoff, 1978; King, 1988; McCredie & Timlake, 1983; Pettibone & Roddy, 1987; Pierce & Cooley, 1985; Slatta, 1987). Perhaps one of the reasons computer networking messages contain more objective information is, as mentioned before, the narrow bandwidth of computer networking. Conferences and face- to-face meetings are much more effective for exchanging rites and rituals. The rituals of certain awards, dinners, and presentations which occur at many conferences express the values of the discipline to its members. Without the ability to exchange rites and rituals, computer networking is lacking an important master contract-making element. Future research should include an investigation of unique ways computer networkers may develop their own unique types of rituals exchange. Vallee et al. (1974) and Kochen (1978) argued that computer mediated communication should be investigated in order to discover its own unique and inherent attributes instead of comparing it to face-to-face communication characteristics (Hiltz & Turoff, 1978).

Yet another possible factor that may have caused the limited computer networking effect on culture in this study may be the narrow conceptualization and assessment of organizational culture. Although this study assessed organizational culture using the same technique (grounded technique to uncover constructs followed by quantitative analysis of constructs to determine shared beliefs and ideals) as Pickett and Sorenson (1983) and Harris and Cronen (1979) used, it did not use their complete research design. The final section of both the Pickett and Sorenson and Harris and Cronen studies was an attempt to uncover the rules organizational members use in linking thought to action. Harris and Cronen explained that the expansion of the master contract includes the negotiation of rules (both implicit or explicit) which govern the maintenance of the master contract-building. For example, Harris and Cronen found the following rule was negotiated and used to maintain the academic department which they investigated:

> In a faculty meeting, if the education department presents a teaching improvement plan, then it is legitimate to criticize plan as a waste of time and disregard advice so that theoretical self-image is affirmed and service orientation discouraged. (p. 27)

Eisenberg and Riley (1988) and Smircich and Calas (1987) placed studies such as Harris and Cronen's which are based on organizational constructivism in the "organizational cognition"category of organizational culture studies. Such studies examined "networks of shared meanings that function in a rule-like manner" (Eisenberg & Riley, p. 134). According to Schall (1983),the rules which guide cultural behaviors and interpretations are a unique identifying agent of cultures. According to Blimes (1976) "...different cultures not only have different normative rules but also that members of any one culture interpret particular situations and actions in way different from members of any other" (p. 45). Organizational members share the same set of cultural rules (Schall).

Perhaps because this study did not explore the effects computer networking has on the rules shared by faculty members, it did not produce a complete and accurate picture of the relationship between computer networking and faculty culture. Further research in determining the effects of computer networking on cultures needs to attempt to uncover differences in the set of cultural rules shared by high, moderate, and low level computer networkers.

Another possible explanation for the slight computer networking effect is the relative newness of the technology. Certain technologies may require longer periods of time not only to be accepted but also to affect lifestyles. Future research needs to explore the relationship between the length of time since initial use of computer networking and master contract-making.

Minor effects of computer networking on the shared culture of the discipline and institution Although, computer networking only slightly affected the cultures faculty share with their disciplinary and institutional colleagues, it is important to examine these minor effects. Perhaps the minor effects revealed in this study, are forerunners of the types of changes faculty members may experience with more use of the medium. The minor effects which appeared varied by the component of master contract being investigated, the construct being examined, and the culture being studied.

Components of the master contract differences in the effect of computer networking on shared cultures The different components of master contract-making showed various differences between the computer networking level groups.

Differences in discipline and institution constructs Overall, the three groups shared the same set of constructs. Pickett and Sorenson (1983) refer to such a common set of constructs as a "generic set of sense-making dimensions" (p. 11). However, the frequency of citation of each of the constructs varied by computer networking group. The low and moderate level groups showed slightly more similarity in the frequency of citation of various constructs than the high level group. In other words, those faculty members who use computer networking frequently use slightly different constructs to define the discipline and institution than those who rarely or moderately use computer networking.

This variance between the groups is to be expected when considering the effects computer networking has on the quantity of communication. Constructs are created by organizational member communication. Individuals bring unique meanings to interaction and gradually the communicators coordinate these individual meanings into shared meanings through interaction. These specific, situational-shared meanings are shared with other organizational members and eventually are generalized into shared constructs used to define the organization (Harris & Cronen, 1979). Because computer networking increased the communication between remote colleagues, more meanings were coordinated and shared between high level computer networkers which then lead to their use of a slightly different set of constructs than those used by low and moderate level computer networkers. Perceptual cliques may begin to form between these tightly linked faculty members. Harris and Cronen (1979) argued that when organizational members use different constructs, they are assigning meaning to reality in different ways and thus constructing a different image of the organization. Since the organizational image guides behavior, organizational members with differing organizational images will act in divergent ways.

<u>Differences in beliefs and ideal states of the discipline and institutions</u> Because increased connectivity increases mutual organizational perceptions (Danowski , 1980; Goodell et al., 1989; Pfeffer,1981; Pickett & Sorenson, 1983; Price, 1975; Newcomb, 1953), and because computer networking increases communication (Freeman & Freeman, 1980; Hiltz, 1984; Hiltz & Kerr, 1981; Hiltz & Turoff, 1978, 1985; Johansen et al., 1979; Kerr & Hiltz, 1982; Palme, 1981; Panko & Panko, 1981; Rice, 1980a; Vallee et al., 1978), it was expected that faculty members who used computer networking

more would hold similar beliefs and ideal states about their discipline and institution which would differ from the beliefs and ideal states of the discipline of those faculty members who used computer networking less. Pfeffer (1982) reported on the relationship between communication and propinquity whereby people who share close proximity are more likely to communication more and thus influence each other more. It was expected that those faculty members who use computer networking to create "electronic next door neighbor" status with remote colleagues would more likely share similar attitudes. Such uniquely shared beliefs would set them apart from the rest of the discipline.

However, the results from the tests on differences between beliefs and ideal states showed that moderate level computer networkers, overall, differed most. Perhaps the manner in which computer networking increases communication needs to more closely examined in future research. Perhaps the low level users are not yet connected enough to increase their communication and thus computer networking fails to affect their views. Vallee et al. (1975) found that new users experience a long initial period before they actually increase their connectivity. High level users may disregard some of their communication in an effort to deal with the information overload which comes with high level computer networking (Hiltz, 1984). Hiltz and Turoff (1985) and Bezilla (1979) explained that users of computer networking experience an exponential growth in the connectivity which eventually may cause informational overloads. Perhaps then, the moderate level users are the most likely group to experience increased connectivity from computer networking and thus experience more similarity in views.

In addition, perhaps the sharing of beliefs and ideal states comes from moderate level computer networkers' stage in developing their new electronic invisible college. Low level users may rely on the traditional informal networks of the discipline. High level users may have successfully converted their traditional informal network to computer networks. However, members of the moderate level group may be in the midst of creating their electronic invisible college. Goodell et al. (1989) found that the relationship between connectiveness and common cultural perceptions was dependent on the phase of group development. Goodell et al.'s data showed that linkage and cultural perceptions were strongest during the second of four points in the history of the group -- during the role and norm creating phase of the group. Perhaps, the moderate level computer networkers of this study are at this role and norm making phase of building their new electronic invisible colleges and thus show more uniqueness in their perception of the discipline. In addition, Hiltz (1984) found that those scientists in the middle levels of productivity and connectivity use computer networking more to improve their professional standing. Perhaps the moderate level user group of this study also use the technology to improve their professional standing.

Besides showing the most uniqueness among the beliefs and ideal states of the discipline and institution, the moderate level group reported the actual and ideal states of disciplines and institutions in more positive ways than the low or high level groups. This may be to due the experience of the other groups with less and more computer networking usage. Those in the low level computer networking group saw themselves as less in the mainstream than those in the moderate and high level groups. Perhaps these more peripheral members of the discipline see the discipline in a less positive light due to their exclusion from the intellectual mainstream. The high level computer networkers may see the discipline less favorably because they have experienced an"electronic greener grass". Scholars have found that computer networkers not only increase the amount of their communication, but also the breadth of it; for computer networking also increases communication between disciplines (Bamford & Savin, 1978; Bezilla, 1979; Bezilla & Kleiner, 1980; Hiltz, 1984; Kerr & Hiltz, 1982). High level users may have developed close relationships with others in other disciplines and discovered favorable qualities in the other disciplines which the astronomy discipline lacks. Therefore, the moderate level group may appear being more positive than the low or high level users due to negative perspectives of the other computer groups.

Differences in satisfaction with the discipline and the institution There were no differences between the groups on their satisfaction with the discipline. However, high level computer networkers showed significantly less satisfaction with the actual state of their Institutions on various constructs. High level users tended to believe that their institution was currently in a less positive state than the moderate and low level users plus desired their institution to be in more positive ideal states than the other two groups. As mentioned in the previous section, perhaps this is due to an "electronic greener grass" effect.

Differences in feelings of sharing beliefs and ideal states of the discipline and the institution Overall, the respondents feel that they are a more heterogeneous group than they really are. Although significant differences appeared between the respondents' beliefs and ideal states on several of the constructs, members from each of the groups failed to sense the differences on these constructs. Instead, they felt that others thought significantly differently than they did on constructs on which they actually agree. The high level group sensed that others view the actual state of the discipline and institution more positively than they do. Also, the low level computer networkers thought that others desire the discipline and institution to be more positive than they do. When feelings of agree or disagreeing on beliefs and ideal states vary from actual agreement and disagreement, organizational members' actions will be confusing and inefficient. Apparently, the moderate level of computer networking not only facilitates variance in beliefs and ideal states, but also aids in estimating the differences between own and others' ideas.

More study needs to be done in the area of the effects of computer networking upon the ability of faculty members to understand each other. Pickett and Sorenson (1983) and Harris and Cronen (1979) explained that coorientation is an essential element of mutually shared organizational images. In order to determine the effects of computer networking upon the ability to see others perspectives accurately, a split plot analysis needs to be conducted whereby a difference between individual views can be compared with the averaged views of others.

Another interesting way to analyze the effect computer networking has on the ability of faculty members' coorientation to their discipline and institution may be to use Laing, Phillipson, and Lee's (1972) interpersonal perspective-taking concept. This type of an analysis would yield three reports on the perceptual differences between the three groups. First, the direct perspective determines if the groups agree or disagree about the actual and ideal states of the discipline. Next, the meta perspective shows the level of understanding of the other's perspective. And finally the meta meta perspective describes the feeling of understanding or misunderstanding. Such an analysis may uncover situations whereby members of one group may think that the discipline is moderately monodisciplinary (direct), think that others think the discipline is more interdisciplinary (meta), and think that others think that they think the discipline is highly interdisciplinary (meta meta). Members of the rest of the group may actually think the discipline is moderately monodisciplinary (direct), and think that others think that it is moderately monodisciplinary (meta), and think that others think they think the discipline is monodisciplinary (meta meta). By comparing these six perspectives, it appears that the original group members agree with the rest of the discipline, but misunderstand or fail to see this agreement . In addition, the group members feel they are misunderstood when the rest of the discipline actually understands them. The results from such an analysis would not only detect differences between the groups on the various perceptual levels, but would also provide a good predictor for communicative effectiveness for each of the groups and the relationship of computer networking to the various levels of effectiveness.

Construct differences in the effect of computer networking on shared cultures From the tests which analyzed differences in the computer networking groups constructs, beliefs, and ideal states, it is clear that the effect of computer networking is contingent upon the type of construct being examined. The construct upon which most of the significant differences arose, was the cooperation construct. The groups varied in their beliefs of the actual cooperation between faculty members in the institution. In addition, groups differed in the feelings of sharing beliefs and ideal states of the discipline and the institution on the cooperation construct.

This may be explained by the close tie this construct has to computer networking. Computer networking is used to aid faculty members in cooperative research (Catlett, 1989; Compton, 1987; Francas & Larimer,1984; Hiltz, 1984; May, 1985; Hiltz & Turoff, 1978; Vallee & Johansen,1974). Results from this study revealed the primarily use of computer networking is to connect distant research partners. in addition, it is notable that the cooperation construct received only moderate frequency of citation ratings. Apparently computer networking does not affect the strongly held constructs, but may cause faculty members to see the discipline and institution differently on less defined tenets.

institutional vs. discipline differences the effect of computer networking on shared cultures Overall, high, moderate and low level computer networkers showed the most differences in the shared culture of their institution. This may be explained by the inability of this study to compare ideas of faculty members of the same institution. Harris and Cronen (1979) argued that each organization holds a unique master contract. And although, higher education scholars such as Clark (1987a) believe that institutions with similar missions affect faculty in similar ways, perhaps that was not the case in this study.

Maybe the reason the study revealed more differences in the institutional master contract due to computer networking was that respondents were describing several different institutional master contracts. More research needs to be done in larger disciplines where the quantity of subjects is such that several different institutional shared cultures can be examined by level of computer networking. Also, future research needs to investigate other types of institutions.

If the variance in the effect of computer networking on institutional and disciplinary shared cultures is an actual effect, perhaps it can be explained by the difference in the relationships faculty members hold with their institutions and those they maintain with their discipline. Clark (1963), Freedman (1979), Kuh and Whitt (1988), and Turner (1971) argued that faculty members identify more with their discipline than with their institution. Master contracting begins as early as undergraduates declare majors and intensifies as discipline members move in and out of graduate school. Apparently, increased communication via computer networking did not adversely affect the strongly held loyalties to the discipline. Perhaps the use of computer networking between discipline members is used to build and maintain a strong bond with all discipline members. However, since the cultures of institutions are less defined and more open to change, maybe computer networking induces factioning.

Future research in this area should include investigation into the relationship between Gouldner's (1957) concept of local vs. cosmopolitan faculty members and computer networking. Computer networking is an excellent medium with which cosmopolitanites can stay connected.

Also, computer networking's effect on other types of disciplines needs to be investigated. Becher (1987), Kuhn (1970), and Lodahl and Gordan (1972) all agree that disciplines like astronomy which are more paradigmatically developed, share a stronger culture and a decreased need to communicate. What effect might computer networking have on discipline members from a discipline with a less strongly held consensus? Freeman and Freeman (1980) attributed part of the high level computer networking usage among newly developing interdisciplinary scholarly groups to the great need they had to communicate.

According to the results, the computer networking groups showed less differences in their master contract-making for the ideal state than the actual state for both their disciplines and institutions. This suggests that the faculty members share ideal visions more than they do actual visions. Such a situation is problematic in reaching goals. When groups differ from the starting place, they can not all reach the same destination via the same routes. For example, the three computer groups all agreed on the ideal state of the institution on the cooperative construct, but the high level group varied significantly on the actual state of the cooperative construct. The high level computer networking group sees the institution's current state as being more uncooperative than the moderate level group. Attempts to promote cooperation may be somewhat ignored by moderate level users for they believe that the goal is more within reach and not a high priority.

Summary

The purpose of this study was to explore the ways computer networking may affect faculty communication and culture. In order to do this three research questions were posed concerning the effects computer networking may have on faculty communication and two were asked regarding computer networking's effects upon faculty culture.

The first research question asked what types of communication tasks do faculty members who use computer networking to communicate with other discipline members located at other institutions accomplish via computer networking. The data showed that although faculty members use computer networking to accomplish a wide variety of tasks, faculty members use computer networking mostly to accomplish information exchange between research teammates and to develop informal networks which aid in providing necessary feedback for the modification of research projects.

Based on the importance of computer networking to these two faculty collaborative groups, further research needs to explore the relationship between co-authored research and invisible colleges. Longitudinal data could provide insight to the correlation between the availability of computer networking and growth in team research. Also, how are computer networks affecting the structure of existing invisible colleges? Are existing invisible colleges becoming electronic invisible colleges while maintaining their membership, structure, and purpose or has computer networking caused some restructuring in invisible colleges? Also, the question remains if computer networks are similar in structure to more traditional informal communication networks. Garvey and Griffith (1971) stated that the essence of the informal communication network is to allow researchers collaboration and feedback with a small, hand-picked group of colleagues. However, as this study reports, users of computer networking tend to communicate more with a greater number of diverse colleagues.

The second question this study addressed the affect of computer networking on the use of traditional faculty communication media. Subjects reported that their use of what they claim to be the two frequently used traditional media (telephone and mail) decreased due to their use of computer networking. They also reported that their use of other media experienced no effect from computer networking. It seems that the ability of computer networking to accomplish various communicative tasks in an effective manner determines whether it will decrease the use of other media or have no effect on it. Since computer networking essentially accomplishes the same that communicative tasks as the telephone and conventional mail in a more effective and efficient way, it decreases the use of these media. However, since it can not accomplish the same communicative tasks as conferencing and journal publications can, it has no effect on their use by faculty members. Further research needs to investigate the relationship between use of the facsimile machine and computer networking. Are these two faculty media complementary or competitive?

The third research question attempted to explore the effect computer networking has upon faculty communication. The results from this part of the study showed that subjects reported that computer networking definitely increases the amount of communication faculty members have with colleagues at other Institutions who use computer networking. These results stem from the respondents' self-reports. In order to understand this relationship more accurately, it would be necessary to study a closed computer network and do a linkage analysis on each respondent. It would be interesting to explore the effect of computer networking on various types of connectivity. Also, research needs to be done on the effect of computer networking has on interdisciplinary communication. In addition, future research which would attempt to pin point the effects computer networking may have upon each communicative step of the research process would be very valuable.

The second half of this study drew upon the conclusions of the first half which focused on the effects computer networking has on communication. If communication is affected by a technology like computer networking, and if communication is the heart of organizational cultures, then it was speculated that computer networking would affect the cultures faculty members share with their disciplinary and institutional colleagues.

Overall, the effect of computer networking on faculty culture was minimal. This may have been due to computer networking's limitation in transmitting nonverbal messages and its inability to exchange rites and rituals -- the essential communication elements of master contract-making. Future research needs to investigate unique types of nonverbal cues and rituals computer networkers may users may adapt and how these affect shared cultures.

The minor effects of computer networking on faculty culture varied by the type of master contract element studied,the culture being studied, and the construct analyzed. High level computer networkers reported the most unique set of constructs. The moderate level computer network users showed the most difference in beliefs and ideal states of the discipline and institution. The high level of computer networkers reported the most dissatisfaction between the actual state and ideal state of the discipline and institution. The low and high level computer networking groups showed more difference between the beliefs and ideal states they hold for their discipline and institution and their beliefs of other's beliefs and ideal states. The cooperation construct was the most common construct on which the computer networking groups differed. Perhaps this was caused by its close tie to computer networking. Subjects' beliefs and ideal states varied most on their opinions toward their institution. Perhaps this difference may be explained by the inability of this study to compare ideas of faculty members of the same institution. Or maybe an actual difference does exist due to faculty members' tendency to make stronger bonds with discipline than the institution. Future research needs to be done with different disciplines, and institutions.

Computer networking has become a very important communication medium to faculty members. According to subjects' reports the use of it has affected the type of media faculty members use and the amount of collaboration with colleagues from other institutions. The effect of computer networking on faculty cultures was minimal. However, the minimal differences give insight into future avenues of research. Such results should not only be noted by communication and higher education researchers, but also by administrators of both disciplines and institutions

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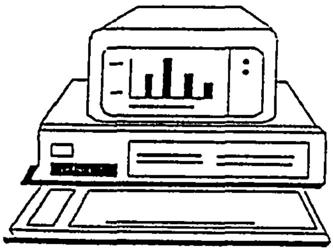
APPENDIX A: SURVEY (PHASE I)



Computer Networking
In the University Environment

I. BACKGROUND ...

1. How many years have you been a full-time member (including postdocs) of an astronomy department at any university? (check one)

    ________ 1-15 years
    ________ 16-30 years
    ________ 31+ years

2. At your current university, what percentage of your time do you spend on teaching? research?

    ________ % of time spent on teaching
    ________ % of time spent on research

3. Rank the following methods according to how often you use each to communicate with members of the astronomy discipline at other institutions. Do not rank those which you do not use. (1=most used, 7=least used)

    ________ conferences
    ________ journals and newsletters
    ________ telephone
    ________ conventional mail
    ________ fax
    ________ computer networking
    ________ other ____________________________

If you ranked "computer networking" in question 3, skip question 4.

4. What is/are the reason(s) why you do not use computer networking to communicate with members of the astronomy discipline at other institutions? (After answering this question, please skip to the next section of the survey entitled "Perceptions of the Astronomy Discipline".)

5. How often do you use computer networking to communicate with members of the astronomy discipline at other institutions? (check one)

________ 1-2 times a month
________ 3-10 times a month
________ 10+ times a month

6. Rank the following tasks according to how often you use computer networking to accomplish them with members of the astronomy discipline at other institutions? Do not rank those which you do not use. (1=most used, 10=least used)

________ to locate and organize persons with similar research interests
________ to prepare joint research proposals
________ to share joint research project information or inferences with research partners
________ to share data sets or statistical logic with research partners
________ to gain feedback on pre-publication drafts of research results
________ to disseminate final research results
________ to access computer software or hardware
________ to accesss equipment (i.e. telescopes)
________ to access astronomy data bases
________ to share teaching methods
________ to informally chat with discipline members
________ other ______________________________

7. If a member of your department wanted to begin computer networking, which of the following hardware is accessible to him or her? (check as many as apply to your situation)

________ university-owned mainframe terminal or personal computer located in each member's office
________ university-owned mainframe terminal or personal computer located within the department
________ university-owned mainframe terminal or personal computer located outside the department

8. ________ Please send me the second phase of this survey via electronic mail rather than U.S. mail. My e-mail address is: ______________

(over)

II. PERCEPTIONS OF THE ASTRONOMY DISCIPLINE ...

Respond to each of the following questions in a word or brief phrase. Instructions on completing the "rating" follow the last question of this section.

1. In your opinion, what makes the astronomy discipline unique among disciplines similar to it?

Rating ____________

2. In what way is the astronomy discipline similar to other disciplines?

Rating ____________

3. How would you describe the astronomy discipline when it is at its best?

Rating ____________

4. How would you describe the astronomy discipline when it is at its worst?

Rating ____________

Next, go back through your responses to the questions in this section and rate how important each response is in determining your overall impression of the astronomy discipline. (1=not at all important, 10=extremely important)

(over)

III. PERCEPTIONS OF YOUR CURRENT UNIVERSITY ...

Respond to each of the following questions in a word or brief phrase. Instructions on completing the "rating" follow the last question of this section.

1. In your opinion, what makes your current university unique among disciplines similar to it?

Rating ____________

2. In what ways is your current university similar to other universities?

Rating ____________

3. How would you describe your current university when it is at its best?

Rating ____________

4. How would you describe your current university when it is at its worst?

Rating ____________

Next, go back through your responses to the questions in this section and rate how important each response is in determining your overall impression of the astronomy discipline. (1=not at all important, 10=extremely important)

THANK YOU FOR YOUR RESPONSES.

APPENDIX B: SURVEY (PHASE II)

APPENDIX C: MEMO TO SUBJECTS

IOWA STATE
UNIVERSITY

College of Education
Professional Studies
N243 Lagomarcino Hall
Ames, Iowa 50011

Telephone 515-294-4143

MEMO

TO:
FROM: Debb Vandehaar-Arens (Iowa State University Ph. D. Candidate)
DATE: February 15, 1990
RE: Returning Survey

I appreciate the time and effort you have spent on the first phase of my survey on computer networking. However, according to my records, you have not returned the second phase of the survey which I sent you on January 28th. Since fewer people received this second phase, your response to it is even more important than the first phase.

If my records are incorrect and you have returned this second salmon-colored survey, please disregard this memo and thank you for your help. However, if you indeed have not returned the second phase of my survey, I would greatly appreciate the time and effort you take to complete it and return it soon. If you have misplaced or lost the survey I sent you in January, please contact me and I will send you another copy.

Thanks for all your help.

Debb Vandehaar-Arens
9 Renshaw Drive
Storm Lake, IA 50588
712-732-1589

APPENDIX D: LETTER TO SURVEY REVIEWERS

November 7, 1989

Dear Astronomy Department Member:

I am contacting you requesting your assistance in pretesting a survey tool for my dissertation research project. I am a doctoral candidate in the higher education program at Iowa State University. For my research project, I am investigating academics' use of computer networking to communicate with peers in their discipline. I am most interested in how those using computer networking extensively may begin to build different perceptions of their disciplines and their institutions. I have chosen to study the astronomy discipline due to its research emphasis and the widespread use of computer networking between its members. My sample consists of full-time teaching faculty and research associates from astronomy departments at the top research universities in the United States.

The pretest will take you approximately 15 minutes. First read the letter of transmittal and then complete the survey. Please time yourself so that I will have an idea of the time it takes to complete the survey. Then respond to my questions regarding the construction of the survey on the separate page. Please return the survey and comments in the self addressed, stamped envelope by November 15.

Thank you very much for helping me with this important step of my research project. Please contact me (telephone: 712-732-1589 or BITNET: e1.dmv@isumvs) if you have questions.

Sincerely,

Debb Vandehaar-Arens
9 Renshaw Drive
Storm Lake, IA. 50588

APPENDIX E: LETTER TO DEPARTMENT CHAIRS

November 13, 1989

Dr. Thomas Jones, Chair
University of Minnesota
116 Chruch St. - Dept. of Astronomy
Minneapolis, MN 55455

Dear Dr. Jones:

I am writing to request your administrative support in research I am conducting with members (both teaching and research appointments) of your astronomy department at the University of Minnesota. I called your secretary yesterday and obtained a list of the names and addresses of each of the members of your department. On November 16th, I will send each a survey. Would you be able and willing to drop a brief memo in each of.their mailboxes asking them to watch for the survey and then to complete it in a expedient manner? Your help in this project would help increase my response rate greatly.

The survey, concerning the perceptions of astronomy faculty members who use computer networking to communication with their peers in the discipline is a part of my dissertation research. I am a Ph. D. candidate in the higher education program at Iowa State University. The results of this study will help provide an understanding not only of how many astronomy department members are using computer networking, but also the implications this contemporary medium may have upon disciplines and universities.

In order to collect information on this topic, I selected a random sample of departments of astronomy in top research universities across the nation and your department was selected as one of the sample departments. If my conclusions are to truly represent departments of astronomy, I need to have all of your departmental members respond. Your departmental members will be receiving the first part of a two-phase instrument around November 17th or 18th. Using responses to this survey, I will construct a second survey and send it to them the first week in December. Both phases of the instrument have been pre-tested by members of astronomy departments at other top research universities. Both phases will take approximately 10-15 minutes each to complete.

If you wish, I will share with you a summary of the results of this research project upon completion. Contact me (telephone: 712-732-1589 or BITNET: e1.dmv@isumvs) if you have questions. Thank you for your supportive help.

Sincerely,

Debb Vandehaar-Arens
9 Renshaw Drive
Storm Lake, IA 50588

APPENDIX F: LETTER TO AAS EXECUTIVE OFFICER

Nov. 1. 1989

Peter Boyce
Executive Officer
American Astronomical Society
2000 Florida Avenue
Washington. DC 20009

Dear Mr. Boyce:

I am writing to request an AAS endorsement of research which I am conducting with AAS members. I believe the results of my study will be valuable to AAS.

I am a doctoral student in the higher education program at Iowa State University. My dissertation research is entitled "Computer networking among astronomy faculty members : The effects computer networking has on astronomy faculty members' perceptions of their discipline and institutions".

The purpose of the research is to investigate how astronomy department members using computer networking to communicate with peers in the astronomy discipline may be developing a different perception of their discipline, their institution, or both. Pickett and Sorenson (1983) based their research upon Harris and Cronen's (1979) study and found that differences in organizational members' communication quantity affects members' basic perceptions of the organization. Since computer networking increases the amount of communication between users (Hiltz & Turoff, 1978) this study mirrors Pickett and Sorenson's methodology. And since faculty members are simultaneous organizational members of their discipline and their institution (Becher, 1987; Ruscio, 1987), this study compares faculty members' perceptions of both their discipline and institution.

Approximately 300 AAS members who are also members of astronomy departments at "research universities I" will participate in this study. Each of the three groups (categorized by level of computer networking usage) will have approximately 100 members. The data for this research will be gained from a two-phase survey. Section one of the first phase of the survey will request a self report on the subject's amount of computer networking activity (the independent variable). In order to determine appropriate categories by which subjects could describe their level of computer networking, the researcher will interview ten members of the astronomy discipline from various research universities I's not selected for the sample. (This same group of experts will also be used to pretest the instrument described below.) Section two of the first phase of the survey will request astronomy department members to describe construct continuums with which they build their image of their discipline and institution. For each group, independent judges will establish functionally equivalent categories for the subjects' reported constructs and build the second phase of the survey. This second phase will ask subjects their perceptions and their perceptions of their peers' perceptions of each organization's ideal and actual state on each of the commonly generated construct continuums (from phase one).

The data collected will be statistically analyzed in two ways. In the first phase of the survey, the section two will request astronomy department members to rate their constructs of the organizational image of both their discipline and their institution. A mean rating of importance of each construct will be computed for all groups for both discipline and institutional constructs. In the second phase of the survey, Wilcoxon T-tests will be made on the following four comparisons: own perceptions of ideal vs. others' perceptions of ideal, own perceptions of actual status vs. others' perceptions of actual status, own perception of actual status vs. others' perceptions of ideal, and own perception of ideal vs. others' perceptions of actual.

Dr. Larry Ebbers, chair of the Professional Studies department at Iowa State, is the chair of my committee and would be able to validate my research project. He may be reached by telephone at 515-294-4143.

This research is important not only for higher education and communication scholars, but also your association. First, astronomy department members' perceptions of their discipline should interest the AAS staff. In addition, if it is found that those astronomy department members using computer networking extensively are perceiving their discipline and thus AAS significantly more positively than those not using this medium, AAS may want to promote computer networking even more. In essence, I believe AAS will be able to benefit from the conclusions of my study. And I will be more than happy to send these to you at the completion of my project.

However, at this point, I need to work toward achieving a high response rate so that accurate conclusions may be reached. Your support of my project could aid in a higher rate of return. Would you be able and willing to write a brief letter (on AAS letterhead) of endorsement of my study which I could send along with my survey? I would like to send the first phase survey by November 6th. I apologize for such short notice.

Thank you for your consideration on this matter. I look forward to receiving your letter in the mail. If you have questions regarding this request or my research, feel free to either call me on the telephone at (712-732-1589) or send me a message via electronic mail.

Sincerely,

Debb Vandehaar-Arens
9 Renshaw Drive
Storm Lake, IA 50588

APPENDIX G: SURVEY (PHASE I) COVER LETTER

IOWA STATE UNIVERSITY

College of Education
Professional Studies
N243 Lagomarcino Hall
Ames, Iowa 50011

Telephone 515-294-4143

November 17, 1989

Dear Astronomy Department Member:

Computer networking is becoming an important medium by which academics communicate with their peers at other institutions. Scholars in the field of higher education are interested in how this contemporary means of academic communication may affect the academic environment. Research shows that changes in the way members of organizations communicate affect the image each member builds of the organization. Therefore, it is necessary to examine the effects computer networking may have on the way academics view their disciplines and universities. As a doctoral candidate in the higher education program at Iowa State University, I have chosen to investigate this important topic for my dissertation research.

In order to collect information on this topic, I selected a random sample of departments of astronomy from top research universities across the nation. The discipline of astronomy was chosen due to its research emphasis and the widespread use of computer networking between its members. Your department has been selected as one of the sample departments. If my conclusions are to truly represent departments of astronomy, I need your help. The enclosed survey is the first part of a two-phase instrument. From your responses on this first phase, the second phase will be constructed and sent to you in mid-December. Both phases of the instrument have been pre-tested by members of astronomy departments at other top research universities. Each phase only takes approximately **15 minutes** to complete.

I would appreciate you completing the enclosed survey by **December 1st** and returning it in the enclosed self-addressed, stamped envelope. Your responses to the survey questions will be held in strictest confidence. If you wish, I will share with you the results of this research project upon completion. Contact me (telephone: 712-732-1589 or BITNET: E1.dmv@isumvs) if you have questions. Thank you for your cooperation.

Sincerely,

Debb Vandehaar-Arens
9 Renshaw Drive
Storm Lake, IA 50588

APPENDIX H: MEMOS TO NONRESPONDENTS (PHASE I)

MEMO

TO: Astronomy Department Member
FROM: Debb Vandehaar-Arens (phone: 712-732-1589)
DATE: December 8, 1989
RE: Computer Networking Survey

Several weeks ago I sent you a survey asking about your use of computer networking and perceptions of your institution and discipline. My records show that you have not yet returned the survey. Because the data I have received from other astronomy department members looks interesting, I am very anxious to begin my statistical analysis. However, I can not proceed until I obtain a higher response rate. Please complete and return your survey so that my conclusions will truly represent astronomy departments.

If you have misplaced the salmon-colored survey you received the last week in November, contact your departmental secretary for another copy.

Thanks again for your cooperation. If you have already returned the survey please disregard this memo and thank you for your help. If you have any questions please contact me.

APPENDIX I: SURVEY (PHASE II) COVER LETTER

IOWA STATE UNIVERSITY

College of Education
Professional Studies
N243 Lagomarcino Hall
Ames, Iowa 50011

Telephone 515-294-4143

January 26, 1990

Dear Astronomy Department Member:

Thank you very much for responding to the first phase of my study on computer networking. This final phase will only take approximately 15 minutes to complete. Due to a smaller number of people receiving this second phase of my survey, your responses are valued even more than those of the first phase.

This survey begins by asking for more specific information regarding your academic communication and computer networking. I apologize for repeating a question which I asked earlier regarding your computer networking usage rate. However, since I had to modify my usage categories, I need to double check your response to this question. The last sections of this survey are built from your responses to the open-ended perception questions on the previous survey.

As I mentioned in the previous cover letter, my study is looking at the effects computer networking may have on your perception of your discipline and university. Since we know that computer networking provides a new way of communicating and since we also know that changes in communication affect the images people build of organizations, it is necessary to examine the effects computer networking may have on the way academics view their disciplines and universities. As a doctoral candidate in the higher education program at Iowa State University, I have chosen to investigate this important topic for my dissertation research.

If my conclusions are to truly represent departments of astronomy, I need your help. Please complete this final survey and return it in the self-addressed, stamped envelope by **February 7th**. In the case that you have been on vacation and thus have missed the above deadline, please complete the survey and send it back to me as soon as possible.

Your responses to the survey questions will be held in strictest confidence. You may notice the identification code in the upper right-hand corner of your survey. This code will remain on your returned survey until the non-respondents have been identified and contacted. At that time, this identification code will be eliminated from the surveys. Your name will never be placed on the survey or associated with research findings. If you wish, I will share with you a summary of the results of this research upon completion. Contact me (telephone: 712-732-1589 or BITNET: el.dmv@isumvs) if you have questions.

Thank you for your cooperation on all parts of my research.

Sincerely,

Debb Vandehaar-Arens

Debb Vandehaar-Arens
9 Renshaw Drive
Storm Lake, IA 50588

APPENDIX J: MEMOS TO NONRESPONDENTS (PHASE II)

IOWA STATE
UNIVERSITY

College of Education
Professional Studies
N243 Lagomarcino Hall
Ames, Iowa 50011

Telephone 515-294-4143

MEMO

TO:
FROM: Debb Vandehaar-Arens (Iowa State University Ph. D. Candidate)
DATE: February 15, 1990
RE: Returning Survey

I appreciate the time and effort you have spent on the first phase of my survey on computer networking. However, according to my records, you have not returned the second phase of the survey which I sent you on January 28th. Since fewer people received this second phase, your response to it is even more important than the first phase.

If my records are incorrect and you have returned this second salmon-colored survey, please disregard this memo and thank you for your help. However, if you indeed have not returned the second phase of my survey, I would greatly appreciate the time and effort you take to complete it and return it soon. If you have misplaced or lost the survey I sent you in January, please contact me and I will send you another copy.

Thanks for all your help.

Debb Vandehaar-Arens
9 Renshaw Drive
Storm Lake, IA 50588
712-732-1589

APPENDIX K: TABLES

Table K.1 Universities where respondents are employed, by part of survey completed

Level of computer networking	Case Number (PCT)	Columbia Number (PCT)	Cornell Number (PCT)	Harvard Number (PCT)	Indiana Number (PCT)	New Mexico State Number (PCT)	Pennsylvania State Number (PCT)	Illinois Number (PCT)
Only Phase I.I	0 (0)	0 (0)	0 (0)	1 (6.7)	0 (0)	1 (6.7)	1 (6.7)	2 (13.3)
Phase I.I & Phase I.II	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (33.3)	0 (0)
Phase I.I, I.II & I.III	0 (0)	0 (0)	1 (2.1)	7 (14.9)	0 (0)	0 (0)	4 (8.5)	7 (14.9)
Phase I.I & Phase II	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (9.1)
Phase I.I, I.II, & Phase II	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (16.7)	0 (0)
Both phases completely	1 (1.1)	3 (3.2)	3 (3.2)	9 (9.7)	3 (3.2)	1 (1.1)	4 (4.3)	9 (9.7)
Phase I.I & I.III & Phase II	0 (0)	0 (0)	0 (0)	1 (33.3)	0 (0)	0 (0)	0 (0)	1 (33.3)
Total	1 (.6)	3 (1.7)	4 (2.2)	18 (10.1)	3 (1.7)	2 (1.1)	11 (6.2)	20 (11.2)

Table K.1 (continued)

Level of computer networking	Maryland Number (PCT)	Michigan Number (PCT)	Minnesota Number (PCT)	Pennsylvania Number (PCT)	Texas Number (PCT)	Virginia Number (PCT)	Washington Number (PCT)
Only Phase I.I	1 (6.7)	1 (6.7)	1 (6.7)	0 (0)	2 (13.3)	0 (0)	1 (6.7)
Phase I.I & Phase I.II	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Phase I.I, I.II & I.III	6 (12.8)	2 (4.3)	2 (4.3)	3 (6.4)	4 (8.5)	4 (8.5)	4 (8.5)
Phase I.I & Phase II	4 (36.4)	0 (0)	0 (0)	0 (0)	4 (36.4)	0 (0)	1 (9.1)
Phase I.I, I.II, & Phase II	1 (16.7)	1 (16.7)	1 (16.7)	0 (0)	1 (16.7)	1 (16.7)	0 (0)
Both phases completely	5 (5.4)	4 (4.3)	2 (2.2)	2 (2.2)	11 (11.8)	8 (8.6)	4 (4.3)
Phase I.I, I.II & Phase II	0 (0)	0 (0)	0 (0)	0 (0)	1 (33.3)	0 (0)	0 (0)
Total	17 (9.6)	8 (4.5)	6 (3.4)	5 (2.8)	23 (12.9)	13 (7.3)	10 (5.6)

Table K.1 (continued)

Level of computer networking	Wisconsin Number (PCT)	Yale Number (PCT)	Chicago Number (PCT)	Total Number (PCT)
Only Phase I.I	1 (6.7)	1 (6.7)	2 (13.3)	15 (8.4)
Phase I.I & Phase I.II	1 (33.3)	1 (33.3)	0 (0)	3 (1.7)
Phase I.I, I.II & I.III	2 (4.3)	1 (2.1)	0 (0)	47 (26.4)
Phase I.I & Phase II	0 (0)	1 (9.1)	0 (0)	11 (6.2)
Phase I.I, I.II, & Phase II	0 (0)	0 (0)	0 (0)	6 (3.4)
Both phases completely	7 (7.5)	5 (5.4)	12 (12.9)	93 (52.2)
Phase I.I, I.III & Phase II	0 (0)	0 (0)	0 (0)	3 (1.7)
Total	11 (6.2)	9 (5.1)	14 (7.9)	178 (100.0)

Chi-square = 82.64, p=.91
Contingency Coefficient = .56

Table K.2 Subjects' reports of experience in the astronomy discipline, by part of survey completed

Part of survey completed	1-15 years Number (PCT)	16-30 years Number (PCT)	31+ years Number (PCT)	Total Number (PCT)
Only Phase I.I	8 (47.1)	9 (52.9)	0 (0)	17 (9.4)
Phase I.I & Phase I.II	2 (66.7)	1 (33.3)	0 (0)	3 (1.7)
Phase I.I, I.II & I.III	24 (51.1)	16 (34.0)	7 (14.9)	47 (26.1)
Phase I.I & Phase II	6 (54.5)	4 (36.4)	1 (9.1)	11 (6.1)
Phase I.I, I.II, & Phase II	4 (66.7)	2 (33.3)	0 (0)	6 (3.3)
Both phases completely	58 (62.4)	26 (28.0)	9 (9.7)	93 (51.7)
Phase I.I, I.III & Phase II	2 (66.7)	1 (33.3)	0 (0)	3 (1.7)
Total	104 (57.8)	59 (32.8)	17 (9.4)	180 (100)

Chi-square = 8.29, p=.76
Contingency Coefficient = .21

Table K.3 Subjects' reports of majority of time spent teaching or researching, by part of survey completed

Part of survey completed	Teaching Number (PCT)	Research Number (PCT)	Teaching & Research Number (PCT)	Total Number (PCT)
Only Phase I.I	0 (0)	11 (64.7)	6 (35.3)	17 (9.6)
Phase I.I & Phase I.II	0 (0)	2 (66.7)	1 (33.3)	3 (1.7)
Phase I.I, I.II & I.III	3 (6.5)	33 (71.7)	10 (21.7)	46 (26.0)
Phase I.I & Phase II	1 (9.1)	10 (90.9)	0 (0)	11 (6.2)
Phase I.I, I.II, & Phase II	0 (0)	4 (66.7)	2 (33.3)	6 (3.4)
Both phases completely	7 (7.7)	70 (76.9)	14 (15.4)	91 (51.4)
Phase I.I, I.III & Phase II	0 (0)	3 (100)	0 (0)	3 (1.7)
Total	11 (6.2)	133 (75.1)	33 (18.6)	177 (100)

Chi-square = 10.26, p=.59
Contingency Coefficient = .23

APPENDIX L: TABLES

Table L.1 Subjects' reports of the most frequent task accomplished by computer networking with members of the astronomy discipline at other institutions, by computer networking user level (From question I.6 of the first phase of the survey -- see Appendix A)

Level of Computer Networking	to locate persons with like research interests Number (PCT)	to prepare joint research proposals Number (PCT)	to share info. & inferences with research partners Number (PCT)	to share data & logic with research partners Number (PCT)
Low	2 (3.2)	10 (15.9)	24 (38.1)	3 (4.8)
Moderate	0 (0)	0 (0)	28 (50.9)	2 (3.6)
High	1 (3.4)	4 (13.8)	12 (41.4)	2 (6.9)
Total	3 (2.0)	14 (9.5)	64 (43.5)	7 (4.8)

Table L.1 (Continued)

Level of Computer Networking	to gain feedback on pre-publication drafts of results Number (PCT)	to disseminate final research results Number (PCT)	to access computer software or hardware Number (PCT)	to access equipment Number (PCT)
Low	5 (7.9)	1 (1.6)	5 (7.9)	2 (3.2)
Moderate	2 (3.6)	0 (0)	4 (7.3)	0 (0)
High	0 (0)	0 (0)	1 (3.4)	1 (3.4)
Total	7 (4.8)	1 (.7)	10 (6.8)	3 (2.0)

Table L.1 (Continued)

Level of Computer Networking	to access astronomy data bases Number (PCT)	to share teaching methods Number (PCT)	to informally chat Number (PCT)	other Number (PCT)	total Number (PCT)
Low	1 (1.6)	0 (0)	7 (11.1)	4 (7.3)	63 (42.9)
Moderate	0 (0)	0 (0)	17 (30.9)	2 (3.2)	55 (37.4)
High	0 (0)	0 (0)	8 (27.6)	0 (0)	29 (19.7)
Total	1 (.7)	0 (0)	32 (21.8)	3 (2.0)	147 (100.0)

Chi-square = 32.97, p=.16
Contingency Coefficient = .43

Table L.2 Subjects' reports of the second most frequent task accomplished by computer networking with members of the astronomy discipline at other institutions, by computer networking user level (From question I.6 of the first phase of the survey -- see Appendix A)

Level of Computer Networking	to locate persons with like research interests Number (PCT)	to prepare joint research proposals Number (PCT)	to share info. & inferences with research partners Number (PCT)	to share data & logic with research partners Number (PCT)
Low	2 (3.2)	7 (11.3)	13 (21.0)	8 (12.9)
Moderate	0 (0)	9 (16.4)	14 (25.5)	11 (20.0)
High	1 (3.4)	4 (13.8)	8 (27.6)	5 (17.2)
Total	3 (2.1)	20 (13.7)	35 (24.0)	24 (16.4)

Table L.2 (Continued)

Level of Computer Networking	to gain feedback on pre-publication drafts of results Number (PCT)	to disseminate final research results Number (PCT)	to access computer software or hardware Number (PCT)	to access equipment Number (PCT)
Low	5 (8.1)	0 (0)	4 (6.5)	1 (1.6)
Moderate	4 (7.3)	1 (1.8)	3 (5.5)	0 (0)
High	4 (13.8)	0 (0)	1 (3.4)	0 (0)
Total	13 (8.9)	1 (.7)	8 (5.5)	1 (.7)

Table L.2 (Continued)

Level of Computer Networking	to access astronomy data bases Number (PCT)	to share teaching methods Number (PCT)	to informally chat Number (PCT)	other Number (PCT)	total Number (PCT)
Low	2 (3.2)	1 (1.6)	14 (22.6)	5 (8.1)	62 (42.5)
Moderate	3 (5.5)	0 (0)	10 (18.2)	0 (0)	55 (37.7)
High	0 (0)	0 (0)	6 (20.7)	0 (0)	29 (19.9)
Total	5 (3.4)	1 (.7)	30 (20.5)	5 (3.4)	146 (100.0)

Chi-square = 18.11, p=.87
Contingency Coefficient = .33

Table L.3 Subjects' reports of the third most frequent task accomplished by computer networking with members of the astronomy discipline at other institutions, by computer networking user level (From question I.6 of the first phase of the survey -- see Appendix A)

Level of Computer Networking	to locate persons with like research interests Number (PCT)	to prepare joint research proposals Number (PCT)	to share info. & inferences with research partners Number (PCT)	to share data & logic with research partners Number (PCT)
Low	1 (1.9)	14 (26.4)	6 (11.3)	5 (9.4)
Moderate	2 (3.7)	4 (7.4)	7 (13.0)	14 (25.9)
High	0 (0)	3 (10.7)	4 (14.3)	4 (14.3)
Total	3 (2.2)	21 (15.6)	17 (12.6)	23 (17.0)

Table L.3 (Continued)

Level of Computer Networking	to gain feedback on pre-publication drafts of results Number (PCT)	to disseminate final research results Number (PCT)	to access computer software or hardware Number (PCT)	to access equipment Number (PCT)
Low	6 (11.3)	0 (0)	2 (3.8)	1 (1.9)
Moderate	7 (13.0)	1 (1.9)	10 (18.5)	1 (1.9)
High	8 (28.6)	1 (3.6)	1 (3.6)	0 (0)
Total	21 (15.6)	2 (1.5)	13 (9.6)	2 (1.5)

Table L.3 (Continued)

Level of Computer Networking	to access astronomy data bases Number (PCT)	to share teaching methods Number (PCT)	to informally chat Number (PCT)	other Number (PCT)	total Number (PCT)
Low	4 (7.5)	1 (1.9)	11 (20.8)	2 (3.8)	53 (39.3)
Moderate	1 (1.9)	0 (0)	5 (9.3)	2 (3.7)	54 (40.0)
High	0 (0)	0 (0)	6 (21.4)	1 (3.6)	28 (20.7)
Total	5 (3.7)	1 (.7)	22 (16.3)	5 (3.7)	135 (100.0)

Chi-square = 40.15, p=.06
Contingency Coefficient = .48

APPENDIX M: TABLES

Table M.1. Subjects' reports of the most frequently used media to communicate with members of the astronomy discipline at other institutions, by computer networking user level (From question I.3 of the first phase of the survey -- see Appendix A)

Computer Networking Level	Conferences Number (PCT)	Journals & Newsletters Number (PCT)	Telephone Number (PCT)	Mail Number (PCT)	Computer Networking Number (PCT)	Total Number (PCT)
Low	6 (7.5)	21 (26.3)	33 (41.3)	8 (10.0)	12 (15.0)	80 (48.5)
Moderate	2 (3.7)	4 (7.4)	11 (20.4)	3 (5.6)	34 (63.0)	54 (32.7)
High	0 (0)	1 (3.2)	8 (25.8)	1 (3.2)	21 (67.7)	31 (18.8)
Total	8 (4.8)	26 (15.8)	52 (31.5)	12 (7.3)	67 (40.6)	165 (100.0)

Chi-square = 45.65, p=.00
Contingency Coefficient = .47

Table M.2 Subjects' reports of the second most frequently used media to communicate with members of the astronomy discipline at other institutions, by computer networking user level (From question I.3 of the first phase of the survey -- see Appendix A)

Level of computer networking	Conferences Number (PCT)	Journals & Newsletters Number (PCT)	Telephone Number (PCT)	Mail Number (PCT)	Fax Number (PCT)	Computer Networking Number (PCT)	Total Number (PCT)
Low	12 (15.2)	5 (6.3)	20 (25.3)	22 (27.8)	1 (1.3)	19 (24.1)	79 (48.2)
Moderate	3 (5.6)	5 (9.3)	27 (50.0)	5 (9.3)	1 (1.9)	12 (22.2)	54 (32.9)
High	2 (6.5)	2 (6.5)	14 (45.2)	1 (3.2)	4 (12.9)	8 (25.8)	31 (18.9)
Total	17 (10.4)	12 (7.3)	61 (37.2)	28 (17.1)	6 (3.7)	39 (23.8)	164 (100.0)

Chi-square = 31.65, p=.00
Contingency Coefficient = .40

Table M.3 Subjects' reports of the third most frequently used media to communicate with members of the astronomy discipline at other institutions, by computer networking user level (From question I.3 of the first phase of the survey -- see Appendix A)

Level of computer networking	Conferences Number (PCT)	Journals & Newsletters Number (PCT)	Telephone Number (PCT)	Mail Number (PCT)	Fax Number (PCT)	Computer Networking Number (PCT)	Other Number (PCT)	Total Number (PCT)
Low	20 (25.6)	11 (14.1)	12 (15.4)	21 (26.9)	5 (6.4)	9 (11.5)	0 (0)	78 (47.9)
Moderate	5 (9.3)	9 (16.7)	10 (18.5)	21 (38.9)	4 (7.4)	4 (7.4)	1 (1.9)	54 (33.1)
High	2 (6.5)	4 (12.9)	4 (12.9)	17 (54.8)	2 (6.5)	2 (6.5)	0 (0)	31 (19.0)
Total	27 (16.6)	24 (14.7)	26 (16.0)	59 (36.2)	11 (6.7)	15 (9.2)	1 (.6)	163 (100.0)

Chi-square = 16.10, p=.19
Contingency Coefficient = .30

APPENDIX N: TABLE

Table N.1 Mean Rating of Importance of Frequently of Cited Constructs Subjects Use to Define the Astronomy Discipline by Computer Networking Level Group (From questions II.1-II.4 of the first phase of the survey)

Constructs	% Low Users (N=63)	% Moderate Users (N=48)	% High Users (N=29)
Interdisciplinary vs. Monodisciplinary	7.1	6.6	6.9
Scientific Based vs. Artistic Based	7.0	8.7	6.8
Quality Research vs. Weak Research	6.6	5.9	6.0
Cooperative vs. Uncooperative	4.8	5.6	4.7
Observation vs. Experimentation	6.0	5.8	5.2
Broad scope vs. Narrow scope	7.1	7.4	5.5
Fun vs. Boring	7.9	7.6	8.6

APPENDIX O: MEMO & POSTCARDS TO ORIGINAL HIGH LEVEL USERS

MEMO

TO: Astronomy Department Member
FROM: Debb Vandehaar-Arens (Iowa State University Ph. D. Candidate)
DATE: December 20, 1989
RE: Computer Networking Usage Rate

Thank you for returning the first phase of my survey on computer networking. On the survey, you checked the "10+" category when asked how many times a month you used computer networking to communicate with members of the astronomy discipline at other universities. I hate to bother you again during this busy time of year, but before I can construct the second phase of the survey, I need a more articulate measurement of your use of computer networking. Please fill in the blank on the enclosed self-addressed postcard and drop it back in the mail to me as soon as possible.

Thanks for all of your cooperation.

Approximately how many times per month do you use computer networking to communication with members of the astronomy discipline at other universities?

__________ times per month

ACKNOWLEDGEMENTS

Because the completion of a dissertation was a new and exciting challenge for me, I asked for and graciously received the help of many. I thank my committee for allowing me to pursue my research interests and providing valuable feedback and support. I appreciate the ongoing help from librarian, Jodie Morin, for helping me access a host of resources from this fairly remote spot in Northwest Iowa. I appreciate the help and encouragement of friends like Andriette Wickstrom, Hollace Drake, and Dr. Robert Ferguson. I appreciate the time Joe Shields of the University of California in Berkeley contributed in helping me to understand the way astronomers think and talk. I appreciate the time and energy each of the respondents gave in completing both phases of my survey. I appreciate the statistical expertise and accessibility of Alyce Holland and the electronic mail expertise of Wayne Haber, both of ISU. I thank the secretarial staff of the Professional Studies offices at ISU for helping me to connect with my committee members and always finding me a place to study when I was on campus. A big thanks goes to Mom and Dad for instilling the desire and energy to always go forward. And finally, I thank a person who not only helped me finance this project, licked envelopes, and corrected my grammar, but volunteered to ride beside me on this emotional roller coaster -- holding on to me when I thought I might fall out and screaming in exhilaration with me at the high peaks. Thanks so much, Daniel.