USAGE AND MOTIVATIONS OF A LARGE
ELECTRONIC BULLETIN BOARD SYSTEM

by

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ABSTRACT

Persons with access to computers have a new, powerful medium for communication. Computer-mediated communication systems offer support for transmitting electronic mail among the users, allowing affinity groups of similar interest to form. Electronic bulletin boards which are accessible to groups of users offer the capability to add messages to a running dialogue among group members with retention of the dialogue to allow members to review the conversation at their leisure.

This thesis explores a large corporate electronic bulletin board system which addresses topics related to personal computers. First, the characteristics of the bulletin board system are addressed, including the number of separate bulletin boards, the subjects addressed, number of participants, and the locations of the participants. Next, a sample of messages is analyzed for the types of information covered in the bulletin boards. The information is classified as being technical or not, and as being a question, answer or expository remark. Analysis relates these classifications to participation frequency and location of users. Finally, a survey of all heavy users and a sample of all other users is analyzed to determine motivations and satisfaction.

One major conclusion of this thesis is that users are overwhelmingly satisfied with the problem resolution capabilities of the bulletin board system. Users draw on company-wide expertise with ease, and rate the system's effectiveness in resolving problems to be greater than use of reference manuals or consultation with local experts. Another major conclusion is that not only is the system effective, it is the first mechanism consulted when a problem arise which implies a low social cost for the mechanism. The data of the thesis suggest that gatekeeper roles may exist for the frequent participants since this group rates assisting others as a high personal motivation as well as being very well read on bulletin board topics.

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Title: Professor of Management

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Title: Associate Professor of Management
DEDICATION

This thesis is dedicated to my father, J. D. George, with whom I can now intelligently discuss surveys and statistics, and to my wife, Diane Figueroa, and two children, Christopher and Stephanie, for their patience in my absence in Boston for the year.

BIOGRAPHICAL NOTE

The author received his B.S. in Computer Science at North Carolina State University in December, 1973. He has worked for IBM since graduation, including time in developing telecommunications programs, and later telecommunications algorithms at IBM Research in Yorktown Heights. Most recently, he was responsible for the architecture, design, and performance of the IBM Token Ring Local Area Network. He is also an adjunct assistant professor in computer science at North Carolina State University.
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Chapter 5

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CHAPTER 1: INTRODUCTION AND METHODOLOGY

1.1 COMMUNICATION TECHNOLOGIES

Many important research and development endeavors require the cooperation of large numbers of people from diverse backgrounds. The success of such endeavors necessitates effective communication among the participants. Some of mankind's most significant inventions directly improve communication effectiveness by providing substitutes or cost improvements for existing mechanisms.

For example, trains, and then airplanes, allowed distant people to gather for the most intense form of communication, face-to-face exchanges replete with voice and visual cues. Elaborate railway systems and airline systems were developed to meet the demand to move people to the places desired.

Voice communication mechanisms, particularly telephones, provided a less intimate alternative means of communication for situations in which travel was not cost effective. And the distance need not be great for the telephone to become cost effective. Imagine the chaos which would result in even a small office building today if the intra-office communication by telephone was removed. Secretaries would run about halls, setting up key meetings; managers would wander about looking for each other to share important ideas. Pool [Pool, et al., 1977] points out that the telephone enabled skyscrapers; without telephones, a tall building would be all elevator shafts to enable messengers to move into and within the building supporting the workers. The importance of the telephone in daily activities has spawned a nearly world-wide communications network to support the distribution of voice.

When two parties can not travel or communicate orally, perhaps for reasons of cost, written transmissions are often
substituted. Besides being an inexpensive technology in both media and transportation cost, written communication offers an asynchronous exchange with a naturally permanent history. The asynchronous nature is particularly important; parties do not have to agree on a time in order to communicate. The importance of this means of communication is reflected by the first highway system developed in the newly formed United States, justified completely on making it easier to move mail around the region.

Written communication also allows broadcast; books or newspapers have elaborate cost effective distribution mechanisms to allow a general, one-way communication to a broad audience. The capability for group reply is limited, however.

Computer-assisted communication is now taking its place in this spectrum of communication enabling technologies.

**Information Distribution Opportunity**

The opportunity for computer-assisted communication reached a practical level with the advent of time-shared computer systems. Such systems allowed a person to use a computer simultaneously with other users. This computer system served as a natural communication distribution medium among these users, and soon bright programmers developed methods to exchange messages with each other, both synchronously (exchanges while all participants were using the computer at the same time) and asynchronously (through computer versions of "mail boxes"). In addition, broadcast mechanisms for sending a single message to all users were created to inform the user community of events of common interest such as new programs or changes in the hours of operation.
The value of communicating through the computer did not escape management attention for long, and soon formal communication mechanisms were created to standardize and facilitate exchanges. Electronic mail, or E-mail, refers to the most popular computer communication mechanism featuring asynchronous communication (like written mail) and the use of computer "mail boxes" to receive and hold messages for a user. Such systems often allow nicknames, shorthand notations for addressees, to facilitate sending messages. A note to your manager would be sent to "Boss" rather than his full name and address; the computer would supply name and address from the nickname.

Since the system is completely electronic, the message transmitter can send several copies of a message almost as easily as a single copy. Indeed, most systems with nickname support also allow group nicknames, like "Dept" for the names and addresses of all members of your department. A powerful communication distribution system is created when this capability exists and is well known among the users [Feldman, 1986].

Parallel to the development of E-mail capabilities, another revolution in computer system technology was occurring: Computers were being linked together for electronic transmissions among them. The computers could literally be adjacent to each other with a large cable snaking between them, or could be on opposite coasts communicating through orbiting satellites.

If the communicating computers are time-shared machines, the associated user communities also become linked. Electronic mail service can be established between these communities. The impact on written communication is immense; delivery time of days becomes minutes or seconds for written compositions. Compounding this increase in speed is the elimination of secretaries to type correspondence; a user
simply keys in her own message using the computer as the typing station. If typing skills are minimal, short messages are sent which more resemble spoken communication in structure rather than formal written correspondence.

Affinity Groups of Computer Users

The combination of a large, computer-linked group of users and the capability to send messages easily to several people encourages communication among users of like interests, whether related to a new technology or to Saturday golf and tennis. A distribution list of all those users interested in a particular topic can be created and distributed to the group. When a member of the group wishes to comment on the subject, he simply builds a note to the nickname of the group. Each member of the group receives a copy in his E-mail box, and can respond in kind, establishing a running dialogue among the group.

New members can join or old participants can drop out simply by a change in the distribution list. However, each member's distribution list has to be changed, and in any system which is not completely automated, the possibility exists that new members will not get all the correspondence, or ex-members will continue to receive electronic "junk" mail after dropping out. This imperfect communication is the first problem created by a distribution list system, although it can be remedied by centralized distribution lists.

Like paper communication, electronic mail messages can be retained in most systems. For affinity group communication, the total correspondence can serve as a reference history to the ideas and problems of the participants. Readily available computer tools like editors allow easy scanning of the material, perhaps even allowing searches for keywords. Yet inherent in this ability to retain the information is the problem of organizing the information. Should it be organized
by subject, or by author, or by time received? Or perhaps it should be organized in all those ways through indices? The difficulties of each individual participant keeping information of an active affinity group organized may outweigh the value of having organized information or even participating at all for that individual. Hence, organizing the group's information is the second problem of the distribution list system.

If several participants are located on the same time-shared machine, another inefficiency of the distribution list system appears. If each participant keeps all the group correspondence, then multiple copies of the same information exists on the same computer, robbing the computer of valuable computer storage space. Users with finite storage resources may be forced to discard old (but possibly relevant) communication to make room for new. Thus the computer storage duplication problem is a third problem of the distribution list system.

Computer Bulletin Boards as Common Repositories

Computer systems replete with clever, but impatient, programmers devised an alternative system for group communication: computer bulletin boards. The name really captures the idea. Rather than modeling group communication after a newsletter distributed by a post office system, computer bulletin boards present a common "place" for notices to be posted by members of the group.

Individual users compose their messages in the same fashion as before. But rather than sending copies to each member of a distribution list, a single copy is sent to the "bulletin board," a program running on one of the computers. Instead of reading the messages from other members of the distribution group which are in a user's electronic mail box, the user accesses the bulletin board for new messages from the
group. And instead of organizing the information personally and being concerned over computer storage space, only the central bulletin board need be organized and saved.

Therefore many major problems of the distribution list system are addressed by the electronic bulletin board system. In addition, the electronic bulletin board system offers additional advantages. Users now subscribe to the bulletin boards of interest rather than add their names to distribution lists. Users choose the frequency with which they peruse the bulletin boards, rather than having to scanning the dozens of group messages in their mail boxes looking for a more relevant electronic mail message from their manager (see [Malone, et al., 1986] for alternative screening technologies). Users are largely anonymous; a user who only reads the bulletin boards are not bombarded by group messages as the penalty for his bit of curiosity.

If multiple computers are involved in the network, the bulletin board system must be distributed among them to allow easy access for users on any computer. Numerous solutions for timely distribution exist, and are basically the same solutions used for distributed data bases in networks which date back to the early airline passenger reservation systems.

Social Impacts of Electronic Bulletin Boards

Electronic bulletin board systems offer a new vehicle for human communication. What will be its impact, and will it change the methods for doing business? Perhaps it will be just a fast way to deliver written messages to a large audience, replacing newsletters. But perhaps it will impact society to the extent the telephone did.

Since this technology is rooted in computers, the most experienced groups to date are the heavy users of computers, including university communities, large industries, and high
tech firms. Also since this is an emerging technology, innovation is prevalent, particularly in establishments with large numbers of creative programmers who can modify the system to better meet their needs.

This thesis probes the social questions by examining a particular electronic bulletin board system.

1.2 A LARGE COMMERCIAL BULLETIN BOARD SYSTEM

This study focuses on a large commercial electronic bulletin board system which has been in use for over three years. The system uses the large electronic mail network of the company which links 287,000 of the 400,000 employees worldwide, and which is probably the world's largest electronic mail system [Kneale, 1986]. The system is credited with a reducing mailed envelops by six million in 1985, a 19 percent reduction over the previous year. Clearly, the system is used heavily as well as being geographically extensive.

The bulletin board addresses subjects relating to the personal computer -- hardware, applications, operating systems, potential uses -- and operates with the internally developed TOOLS software. The TOOLS system originally evolved to distribute programming tools for the personal computer across the company's sites (hence its name), and soon was expanded with conferencing facilities. Today, 590 separate TOOLS systems are running in the company, with over one hundred with computer conferencing as the primary use. Each of these systems can span several computers in the company with copies of the information residing on each of the "shadow" systems [Chess and Cowlishaw, 1987].

The bulletin board system of this study is just one of those one hundred conferencing systems, albeit the largest; distribution of tools for the personal computer has been separated into another independent TOOLS system. The personal
computer bulletin board system has a single master copy of all text located at corporate research, and over 150 shadow copies in other computers throughout the company [Chess and Cowlishaw,, 1987]. While it is most convenient for a user to have a shadow copy on her particular computer, users on other computers can be automatically informed from the nearest shadow of changes to information of interest. Thus the system is available to the entire located electronic mail population of 247,000 users.

The traffic on this electronic bulletin board system is heavy -- over 300 updates to bulletin boards occur daily. Since its inception, the size of the retained information has grown, and currently stands at about 90 million characters (equivalent to 52,500 pages on the personal computer), despite continuous editing to eliminate information of little future value (repetitious questions and the like.) New information pours in at the rate of 200 pages a day. Over 3500 different individuals have contributed at some point. The number of persons who have read the information can only be estimated; probably at least 20,000 individuals have read some of the information, although the number could be as high as 90,000 [Chess and Cowlishaw, 1987].

1.3 METHOD OF STUDY

The study of this particular bulletin board system progressed through three phases. In the first phase, extensive data were collected on bulletin board usage for an entire month. In particular, a record for each message was retained which included the originator, time of the message, the bulletin board to which the message was appended, and the length of the message.

The data were analyzed by contributions by unique users, contributions to each bulletin board, origin of participant
(international user or not), and cross referencing of these factors. The analysis is reported in Chapter 3.

In the second phase of the study, a sample of specific messages were examined and classified to better understand the content and subjects addressed in the bulletin board system. Messages were classified as being technical or non-technical, and as being questions, answers, or simple conversation. In addition for each message identified as a question or an answer, the matching message (answer or question) was sought and identified.

With this message sample, a search for trends and correlations was undertaken with the demographic data extracted in phase one. Tendencies of particular populations were observed, and influenced the formulation of the third phase. The results of the message sample analysis are addressed in Chapter 4.

In the third phase, a survey was created and distributed to selected groups of the participants. The questions probed participation rates, motivations, and methods of use, as well as basic demographic data on experience and job performance. The survey was distributed to two groups -- the heaviest users and a representative population of the other users -- and was coded by group.

The answers to the over eighty questions were analyzed in two fashions. First based on the participation distinction, significant differences between the two groups were extracted from the data. Second, usage and motivation trends based on respondent demographics (experience, performance, etc.) were sought. These results are reported in Chapter 5 and Chapter 6, respectively.
1.4 SUMMARY OF RESULTS

Chapter 7 summarizes the results of the entire study, and each chapter reporting on a phase of the study closes with a summary of the results of that phase. But a summary here of the overall results is helpful to keep in mind while reading the study in detail.

The most active users of the electronic bulletin board system are experienced programmers. This is reflected by the large number of bulletin board subjects dealing with programming as well as the results of the user survey. In an evolving technology such as electronic bulletin boards, programmers form the lead users in both demand and their ability to modify the system to meet their specific needs.

Participants show significantly stronger personal motivation to contribute, as opposed to meeting specific needs of their jobs. All users rated solving specific problems and simply "keeping up" as their most important motivations for participating.

Despite this strong personal motivation, the heaviest bulletin board users do have job responsibilities related to the subject areas of the bulletin board system.

The effectiveness of the bulletin board system in the opinion of the participants was surprising strong. Reading and participating in bulletin board discussions was the most effective problem resolution mechanism for the users, far outstripping consulting local experts, gleaning the information from the publications, or experimentation with the product itself. Users were also overwhelmingly satisfied with the system.

The effectiveness of the bulletin board system was combined with an apparently low social cost of use. People tend to seek answers by methods offering low risk of potential
embarrassment. The bulletin board system seems to have low social cost. Thus, it provides a double benefit of being effective and having low social cost, a powerful combination suggesting great potential for this communication technology in research and development environments.
CHAPTER 2: REVIEW OF LITERATURE

2.1 COMPUTER-MEDIATED COMMUNICATION SYSTEMS

As computers become more prevalent in everyday use in business, their use as communications media is similarly becoming more widespread. Documentation of this phenomena attracts researchers from both the computer sciences (to build such systems) and the social sciences (to understand the system's uses and impacts).

The role of the computer as a intermediary in human communications is captured by the most popular name for such computer systems, computer-mediated communication systems or CMCS's. Several manifestations of computer-mediated communication systems exist to date, and Sproull and Kiesler [1986] identify three key categories:

Electronic mail, or E-mail: a message transmission system with each message addressed to a specific user or group, with each group having a "mail box" to receive such messages,

Bulletin boards: groups of messages which may be viewed by large numbers of users, organized by the time of message arrival, and

Conferences: groups of messages which may be viewed by large numbers of users, organized by topic.

Sometimes computer conferencing also refers to systems capable of communicating among users who are all currently active on the system. In this case, the computer conference is similar to a telephone conference call except that simultaneous messages are not garbled on each user's screen as happens sometimes with voice conferences [Chess and Cowlishaw, 1987].
The system of this study has characteristics of both conferences and bulletin boards. Like a conference system, messages are grouped by subject; like a bulletin board, messages for that topic are organized by the order in which the messages were received (as opposed to grouping by subtopics or to grouping a question with its answers.) I will not distinguish between these two categories in this study, and will tend to refer to the system in this study as an electronic bulletin board (BB) system.

2.2 COMPARISON OF COMMUNICATIONS MEDIA

McKenney and Doherty [1986] identify four reasons to communicate within an organization: to search for expertise, to solve a specific problem, to exchange general information, and to keep informed. They then proceed to discuss the suitability and effectiveness of commonly used communication techniques to meet these four needs.

Face-to-face (FTF) communication is best suited for communicating complex, basic information. Full use of verbal and sight cues is essential in this communication, as is feedback between the parties during the exchange to indicate how well the information is being communicated. Meetings (group FTF exchanges) are well suited to negotiating and committing; again cues enhance the effectiveness.

The telephone serves as a substitute for the more rich FTF exchanges. With sight cues eliminated, the telephone becomes better suited for communicating simpler items such as project status.

E-Mail as a Communications Medium

At this point in time, electronic mail systems usually serve as a substitute for the telephone. Both the sight and verbal cues are eliminated, rendering the media suitable for
communicating most of the same simple ideas as the telephone allows.

Electronic mail allows a broad range of message formality and structures [Siegel, et al., 1986]. The text can be as brief and informal as a casual phone call, or as formal as any memorandum exerting authority and requiring immediate action. The message can vary in size without concern for geographic boundaries. The complete lack of outside cues (verbal, visual, or otherwise) enhances the focus of the recipient on the relevance of the message itself.

The medium offers some advantages over the telephone [Chess and Cowlishaw, 1987]. While telephone conversations can be set up in less than a minute and proceed at the speed of verbal dialogues, both parties must be simultaneously available for the conversation. In practice, establishing the dialogue falls prey to the insidious "telephone tag," each party returning the other's call and finding that party is no longer available.

Electronic mail resolves the "telephone tag" problem by not requiring the other party to be present when the message is being composed or when the message is delivered. Further, the delivery time for a message is relatively short, comparable to the time to establish a successful telephone conversation and especially favorable compared to normal memorandum delivery times. Also, electronic mail knows no time zone restrictions which tend to narrow the time windows for telephone conversations.

Electronic mail exhibits the many of the advantages of written exchanges. The message can be composed more carefully and be more focused than a similar verbal message formulated during a telephone conversation. The message can be filed for future reference or for forwarding to other parties; in
contrast, telephone messages are more ephemeral, and can loose much in their retelling as popular parlor games attest.

Electronic mail also exhibits a unique advantage over other media. With a group addressing capability, broadcasts to large numbers of users are as easy as the transmission to a single individual [Feldman, 1986; Chess and Cowlishaw, 1987].

Disadvantages of E-Mail

But disadvantages exist for electronic mail [Siegel, et al., 1986]. "Conversation" times are much longer with electronic mail than with typical phone conversations, partly due to the time required to write versus speak, and partly due to time between messages (at least minutes versus a second). Siegel, Dubrovsky, Kiesler, and McGuire cite in their experiments (detailed below) a reduction in message count of forty percent when using electronic mail as compared to other means, partly reflecting the difficulty in message exchanges.

Electronic mail provides no immediate feedback of the quality of the points being made. In conversations, cues such as nods or "hmms" reinforce that the points made are being understood by the other party, and the absence of such cues indicates to the speaker the need for further explanations. No such dynamic feedback mechanism exists with electronic mail. Kerr and Hiltz [1982, 107] claim that experienced users do not miss the immediate feedback synchronous conversations afford; the ability to interact at a time and pace of one's choosing with asynchronous dialogues, plus the lack of wasteful repetition inherent in synchronous conversations, far outweigh the advantages of immediate feedback.

The electronic mail conversation will generally have reduced feelings of embarrassment and guilt when the social cues are missing [Siegel, et al., 1986]. Empathy for the party may be reduced. On the positive side, the fear of
retribution or rejection are reduced, which may encourage a broader, more frank discussion. Whereas consensus may take longer to reach, the solutions are more volatile as well as being more numerous. Participation should be distributed more evenly among the group, and the decision reached could be more radical.

Siegel, Dubrovsky, Kiesler, and McGuire [Siegel, et al., 1986] experimented with three person groups asked to reach a decision, and varied the type of communication method among different groups. With electronic mail, decisions took longer but required fewer messages. A higher percentage of electronic messages were solution proposals; the participants seemed less able to discuss the problem easily and jointly develop a solution. This is both good and bad. A large number of solutions presented enhances the opportunity of finding an excellent one. On the other hand, focusing on solutions requires that participants choose one, while spending more time understanding the problem could result in a more creative, hybrid solution being developed.

As projected, communication was more balanced and less inhibited by an assertive party in the electronic mail situation. With less inhibition, the variance of solutions (choice shift) was larger for electronic mail groups than other groups with direct face-to-face or audio exchanges.

Removing communication restraints has negative effects as well, claim Sproull and Kiesler [1986]. They identify three different classes of constraints: geographic due to the distance between the parties; organizational, dealing with the parties' relative positions within the organization; and situational, dealing with the circumstances of the particular communication event. If the circumstances of the situation -- the position of other party in the organization for example -- are known, a person's behavior in the communication tends to focus on the other party. However, constraints of which the
parties are unaware are not constraints at all, say Sproull and Kiesler. If a person does not know the situational environment, the communication becomes self focused, more extreme in position and tone, and less socially differentiated (after all, who is the other guy?). Sproull and Kiesler conclude that since electronic mail hides social cues, more antisocial behavior should exist, and more extreme decisions should result.

Kerr and Hiltz [1982, 115] succinctly indicate the key advantage of hiding the situational environment: "Computer conferencing creates opportunities for communicating and joining groups without the intrusion of sex, race, physical appearance, or other irrelevant characteristics." In such a prejudice-free environment, the message is judged on content, not source.

Studies by Hiltz [1978] on computer conferencing echo the findings of Siegel, Dubrovsky, Kiesler, and McGuire [1986] for electronic mail. She noted that more time was required to reach decisions in computer conferences, although fewer messages were required. Decisions often could not be reached in short time periods (forty minutes). Opinions were more often volunteered with computer conferencing with less overt agreement or disagreement, and the equality of participation was higher. Hiltz noticed less tendency to maintain a social image or face-maintaining positions when working alone with the terminal.

Requirements for an Effective E-Mail System

Sproull and Kiesler [1986] identify a set of enabling characteristics to build an effective electronic mail system. First, video terminals are essential for speed, allowing the users to easily edit messages and quickly view information.
The capability of transmitting to a group as easily as an individual is also important. This efficiency for the users allows affinity groups to readily communicate.

The electronic mail system should support transmission of all file formats. Spreadsheet data, analysis programs, as well as text must be easily moved to the user community; each form could be important toward supporting the user community.

To the greatest extent possible, each user should have a dedicated terminal which can be active at all times. The speed and effectiveness of electronic mail is severely compromised if "terminal tag" (waiting for access to a terminal) replaces "telephone tag." The automatic notification of the arrival of new mail which most systems offer is effective only with dedicated terminals.

Hiltz and Turoff [1985] suggest an additional feature for success. If the organization using the system is centralized with only routine tasks, messages can be restricted to organizational boundaries. On the other hand, if professionals are dealing with diverse, complex, or non-routine tasks, contacts across hierarchies are required, and electronic messages must be allowed to flow uninhibited. They suggest that it is probably best to let each individual develop his own communication pattern.

Organizational Benefits of E-Mail

The characteristics of electronic mail translate into a set of organizational benefits [McKenney and Doherty, 1986]. Clearly, elimination of telephone tag itself makes the organization more efficient. When meetings are required, agendas and supporting information can easily and rapidly be distributed to the participants beforehand to enhance the productivity of the meeting itself.
Messages sent with electronic mail form a natural record of plans and actions. This temporal information can be retained for historical reference and easily recalled to justify a past decision or to educate a new team member on project rationale.

Networks of expertise can be formed without regard to geography. Broadcast mechanisms can easily find experts on various technologies, or support group problem solving. As use of the electronic mail system becomes more routine within the organization, communication patterns emerge for the organization to analyze solutions, address problems, and keep itself uniformly well informed.

E-Mail Systems Usage and Impacts

Actual studies of the use of electronic mail systems verify both its usefulness and limitations. McKinney [1986] studied a single large organization which used a common electronic mail system in its various departments. He noted a strong correlation between the type of work being done and the level of usage of electronic mail. In particular, departments with heavy usage performed routine tasks requiring much coordination; communication patterns were hierarchical, predominantly flowing between workers and their managers. Departments with light usage typically were addressing complex problems, and department members were relatively independent workers. Departments with intermediate levels of usage were also addressing problems, but of less complexity; the typical member searched extensively for solutions, and exhibited non-hierarchical communication patterns as he consulted his peers. This study reinforced McKinney's hypothesis of the types of communication best suited for electronic mail.

McKinney cited other studies documenting the positive impact of electronic mail. One firm eliminated one entire level of management for a key project with the superior
communication capabilities offered by its electronic mail system. The firm reportedly shortened its product delivery time by 25 percent and eliminated 20 percent of the resources normally required for such a project.

Another firm lacked specific quantitative savings, but felt the enhanced information flow increased quality significantly, as well as provided improved service responsiveness.

Sproull and Kiesler [1986] note that DEC credits its electronic mail system with increasing the speed of decision making, saving them about seven hours a week per worker. Manufacturers Hanover Trust claims three hours saved per week per employee in unreturned phone calls due to their electronic mail system.

Foulger [1987] cites a case of a researcher preparing a significant research paper in a single week, including extensive electronic consultation with numerous experts scattered throughout the United States, and including several reviewed drafts. A corresponding effort several years earlier had taken the same researcher three months.

Feldman [1986] reports that 60 percent of the messages sent with the electronic mail system would not have been sent at all if the system did not exist. She cites a Swedish study which places the figure at 75 percent of the messages.

But there are also reports which raise questions on the value of electronic mail systems. Sproull and Kiesler [1986] note in their study that while 62 percent of the electronic messages would not have been sent had the electronic mail system not existed, most of these messages were not work related. In examining all forms of communication, they noted 38 messages not related to work being transmitted electronically, versus only six similar telephone messages. This does not necessarily represent permanent abuse of the
system, but rather could represent a transitory period as users become familiar with the system and its potential.

2.3 BULLETIN BOARD FEATURES

Electronic bulletin boards are a particular class of computer-mediated communication systems with some unique features. Messages sent to a bulletin board have been compared to want-ads, with the additional capability of easily changing the content for enhanced clarity [Chess and Cowlishaw, 1987]. The system may be modeled after a newsletter with a focus on keeping users informed of the latest development, or modeled after a reference index with a focus on organization by keywords. The system of this study is modeled after the former, the newsletter, with some capabilities for efficient searching.

One advantage of using bulletin boards instead of direct electronic mail interchanges is that questions and corresponding answers remain available for others to see [Chess and Cowlishaw, 1987]. Readers of the bulletin board may have had a similar problem in the past and now understand how to solve it. Perhaps a reader will remember the solution or the location of the solution (the bulletin board) when the problem does arise. Or a reader will search the bulletin board for a previous answer when she first encounters the problem. Regardless, the solution is now generally available, increasing the speed, flexibility, and effectiveness of the user community. Kerr and Hiltz [1982, 118] echo this information advantage, suggesting that users "obtain more deliberate responses to technical questions, with less delay and backed up by written facts" with electronic bulletin boards, and that the quality of work increases due in part to the broader audience which can be involved in a problem.

At least one noted expert claims that the impact of electronic bulletin boards will be less than electronic mail
[Christie, 1981, 73], but concedes that bulletin board systems are moderately useful, particularly in promoting communications [Christie, 1981, 82]. A study by Johansen, DeGrasse, and Wilson [1978] hints at strong behavior changes when a computer conferencing system is used. With much interpretation of their data, they claim changes with whom people work (more distantly located researchers), when people work (more time outside working hours), where people work (home when terminals available), and how people work (favored communication through conferencing for many problem situations).

Requirements for an Effective Bulletin Board System

Feldman [1986] describes requirements for an electronic mail system to effectively support common interest groups. These requirements closely parallel the requirements for an effective electronic bulletin board system, although the way in which the requirements are addressed varies.

Feldman first defines interests very broadly as being anything on which people wish to receive information. With a very large population, it is theoretically possible to establish obscure, narrow interest groups, very much like the narrow disciplines of the invisible colleges of scientists.

Hiltz and Turoff [1985] echo the premise that a computer-mediated communication system must be oriented to small task-oriented groups and communities of interest. Information organized by topic allows new users to quickly "come up to speed" in understanding the past discussions. Group norms are more rapidly formed and disseminated with small groups, members quickly react to subject or taste deviations, and self regulation through social pressure becomes effective. In general, "discussions assume shape, continuity, and social order."

30
To encourage communication on narrow interests, Feldman [1986] says that the cost of communication must be commensurate with the anticipated benefits, and hence the costs associated with electronic mail interchange must be kept very low. In terms of effort (time costs), a well tuned electronic mail system or bulletin board system must support easy creation and transmission of messages. In terms of social cost, the system must mask situational variables and geographic constraints associated with other forms of communication. Not knowing that you are sending messages read by a particular vice president enables you to send the message in the first place. Besides not being constrained by geography or the situation, the group communication must span organizational and temporal boundaries as well. A participant must be able to communicate with others she has not met, whether these people are spatially or organizationally distant. Hiltz and Turoff [1985] particularly rail against organizational restrictions which inhibit the synergy necessary for innovation.

Feldman [1986] claims that the existence of the current set of topics must not constrain the easy creation of a new topic. Interest groups must be free to form at will. In short, all barriers must be removed to support communication between any two people who might share a common interest.

A Hiltz and Turoff [1985] survey revealed that the most useless feature of a system they studied was that it allowed "junk or cute messages." However, the most important feature was the flexibility of information and the allowance for "self-organization." They summarize this paradox nicely: "One person's junk is another's collectibles," borrowing from the flea market analogy. They conclude that the best system allows each individual to control his own destiny.

Feldman [1986] insists that information on the current topics must be readily available, with the key test being
whether it can be printed immediately. No concept of a "critical mass" of information should affect availability; unlike a newsletter, it is always possible to print now. Information must be distributed quickly in minutes rather than the months typical of published newsletters and journals.

The users of the system must be able to select the information relevant to them. Hiltz and Turoff [1985] address the problem of information overload in detail. They view the problem as having two facets, the sheer volume of information and the lack of organization of the information (information "entropy"). Tools supporting topic selection and filtering are essential for the success of the large system. Malone [Malone, et al., 1986] describes advanced screening methods to address the information overload utilizing expert system technology which has been implemented in a prototype system.

Chess and Cowlishaw [1987] argue for an additional requirement. The bulletin board system, they claim, must allow for broad granularity of control. Participation in some topics may need to be restricted to selected persons; participation by some deviant users may need to be constrained. A large bulletin board system with its diversity of topics and individuals requires fine control capabilities for the administrators to keep the system operational.

A system meeting this set of requirements allows people with common interests to communicate effectively at low cost.

Requirements for Bulletin Board Users

An effective electronic bulletin board system places demands on its user community as well. While their diversity of needs demand broad information, these users must develop screening and filtering skills to make effective use of the information [Hiltz and Turoff, 1985]. The development of such system skills is the one positive benefit of information
overload. Further, the users must acclimate themselves to the norms of their interest groups.

Hiltz and Turoff also found that problems with overload were correlated to the experience of the users. Beginners tend to overextend themselves as they discover new interesting topics; intermediate users have established their interests, but feel pressure to "keep up" by reading all material in those interests; the experienced users, however, have faith in the filtering techniques they have learned, and remain most pleased with the system. A system must have tools to support the filtering by these experienced users if it hopes to become a permanently useful tool for them.

Johansen, DeGrasse, and Wilson [1978] summarize factors for organizational acceptance of computer conferencing systems based on their research and observations:

- There must be a perceived need to communicate.
- The system must be highly accessible to users, and it must be reliable;
- Adequate introductions to the system must be provided, and appropriate training in concepts and techniques;
- There must be an "openness" to use the terminal (to type, in the case of computer conferencing);
- There must be minimal conflicting needs or demands on users, e.g. those who really enjoy a lot of travelling will be unlikely to use alternative means of communication;
- There must be an "advocate" within each key organization who encourages use of the system.

2.4 THE IMPORTANCE OF COMMUNICATION

Above I reviewed the structure and features of computer-mediated communication systems. But such systems are of value only if they enable the organizations to accomplish tasks more easily. Hence, I come back to the importance of communication within organizations.
In a Pelz and Andrews [1976] study of several research and development organizations, frequency of communication was positively related to job performance. Further, the number of different contacts was also positively related to performance (both large numbers of contacts within their work group and outside their work group.) Pelz and Andrews also discovered that the method of contact was not important; only the number seemed relevant.

Granovetter [1973] in his classic discussion of "weak ties" extolled the information transmission virtues of infrequent contacts. Information, he claimed, disseminates more broadly through a person's casual contacts than through his strong contacts. Information becomes rapidly "dampened" as the person becomes reluctant to pass on information to close co-workers under the impression that they already know and that he may be embarrassed to be the "last one to know." On the other hand, there is no such group concerns or constraints with his weak contacts, and spreading the information to them entails less risk.

Electronic mail supports the easy maintenance of "weak ties." Feldman [1986] notes the broadly held opinion that information from outside the organization is vital for innovative problem solving. An organization can quickly exhaust local information without adequately addressing a problem, and needs a structure for outside consultations. She predicts electronic mail will have significant organizational impact by encouraging weak ties. McKenney and Doherty [1986] hypothesize that electronic mail can be effectively employed to maintain contacts with persons discovered by the traditional methods of meetings and personal references. Hiltz and Turoff [1985] suggest that computer-mediated communication systems can increase social connectivity (regular contacts) by as much as ten-fold.
However in contrast to the position of McKenney and Doherty, an electronic bulletin board system may become an alternate means of making new contacts without the requirement of an initial FTF introduction. Feldman [1986] notes that spatially separated people with common interests do not communicate because they simply do not know of each other's existence. She suggests that electronic mail can serve to reduce the cost of discovering these affinities. Once they have discovered each other, these people will tend to maintain the weak contacts beneficial to their common interest.

While access to volumes of information which computer systems allow is important for decision making, it is hardly sufficient. Granovetter [1973] notes that people do not act on mass information, but rather require support of the information by someone they know. Feldman [1986] adds that widely shared information only provides a basis for shared interpretation, not necessarily agreement. But bulletin boards offer forums for personal testimonials and frank discussions by unbiased users; even if the source of an opinion is not personally known to an inquirer, the signed unsolicited testimonial from a fellow user carries weight. The information database gains credibility from this complementary personal feedback.

What is the potential impact of computer-mediated communication systems? The expanded options available for computer users in addition to normal communication methods must enrich their environment. In particular, users have additional control over "their communications in terms of timing, intensity, and duration" [Kerr and Hiltz, 1982, 134]. Radical changes should not be expected, however, for as Hiltz and Turoff [1985] note, individuals are not easily sold on any system which "promises change in cognitive processes and organizational social structure." The demands that effective users must learn systems skills may restrict usage until more sophisticated methods of filtering arise. But the promise of
the technology is great; I agree, and summarize with a quote from Hiltz and Turoff [1985]:

Computer-mediated communication systems allow informal communication that is semi-structured and highly adaptive in nature. By increasing the number of individuals who can be involved in informal information flows, we offer them more of an opportunity to pool their talents and expertise, and facilitate the lateral movement of information in organizations.

2.5 FEATURES OF THE SYSTEM UNDER STUDY

The messages in the electronic bulletin board system under study include both appeals for assistance (usually receiving answers within one to two hours) and tips or techniques for working with personal computers and associated applications [Chess and Cowlishaw, 1987]. Recall that this system provides information and feedback support for a complementary distribution system of personal computer tools.

The system supports easy creation of specialized topics to allow narrow interest groups and to keep traffic volume relatively low for each topic. Very active discussions often spawn related new bulletin boards, and occasionally old bulletin boards will be closed down with potential participants referred to a more generic bulletin board.

The bulletin board system adopts the "newsletter" model of interaction discussed above [Chess and Cowlishaw, 1987]. Automated search capabilities are lacking, but more primitive substitutes are hardly inadequate. A participant may use his favorite editor to search for keywords within a topic. Also, several bulletin boards are dedicated to helping a user find the bulletin board of interest. The "ISTHERE" bulletin board is the most popular, with users typically asking, "Is there
something which does ... ?" Short efficient replies can be sent to the asker, usually with reference to another bulletin board for broader discussion of both the problem and solution. This technique draws on the user population as its intelligent index, and appears to quite effective.

Extremely fine system control exists for the administrators [Chess and Cowlishaw, 1987]. The system is written in a language which supports easy enhancements by the users to introduce new tools and control mechanisms.

No geographic restrictions exist for participation, and new bulletin boards can be created with ease. However, the system is restricted to business-related matters. As detailed in the study, this does not seem to restrict the topics discussed.
CHAPTER 3: TRAFFIC ANALYSIS

3.1 INFORMATION GATHERED

To better understand the use of the electronic bulletin boards, data on the contributions to the IBM electronic bulletin board system on personal computers were gathered for an entire month. The month selected was October 1986. Data were collected in the first two weeks of November to minimize discarded information since the bulletin boards are constantly edited by their owners to reduce the space required without sacrificing content, and I wanted to reduce these effects.

Contributions for October should be typical. It is a full work month without major holidays, and with only an average expected vacation influence.

Each electronic bulletin board has a particular format: Each contribution in a bulletin board has a header record which identifies the participant and the time of the contribution to the bulletin board. These bulletin boards reside in the same data base with other PC related information, and a complete identification of all bulletin boards was not made since it would require individual examination of several thousand files. Instead, all the files which included a suffix clearly identifying them as electronic bulletin boards were scanned for October contributions. Later comparison with statistics collected by the department responsible for the electronic bulletin boards showed that over 77.5% of the October traffic was captured this way.

For each identified bulletin board, each contribution was scanned by a program which extracted each October contribution and retained the participant's network address, the time/date stamp, and a count of non-blank text lines in the
contribution. This raw data was moved into a data base for further analysis.

3.2 OCTOBER CONTRIBUTION DEMOGRAPHICS

The analysis reveals that there were 8867 individual contributions in October, representing 108,830 non-blank lines of text. These contributions came from 2146 unique participants. There were a total of exactly 500 different electronic bulletin boards with contributions in October discovered by the above screening process.

The participant's network address also uniquely identifies the participant's network node and physical site. The network node is the computer to which the participant is attached. An average network node supports several hundred users, although there are network nodes with no active users serving as network control points, or as test nodes for developing software systems. In total, there are 2297 nodes in the network, although it cannot be determined readily how many of these nodes actually give their users access to the electronic bulletin boards.

The complete list of network nodes and corresponding sites was loaded into the data base with the contributions. It revealed that the 2146 unique participants were attached to 394 different network nodes scattered across 117 different physical sites worldwide.

The sites were also classified as United States sites (domestic) or not (foreign). Data base demographics for each of these distinction are shown below.
Table 3-1: Domestic and Foreign Participation

<table>
<thead>
<tr>
<th></th>
<th>Domestic</th>
<th>Foreign</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lines of Text</td>
<td>92,604</td>
<td>16,226</td>
<td>108,830</td>
</tr>
<tr>
<td>Contributions</td>
<td>7,531</td>
<td>1,336</td>
<td>8,867</td>
</tr>
<tr>
<td>Participants</td>
<td>1,781</td>
<td>365</td>
<td>2,146</td>
</tr>
<tr>
<td>Network Nodes</td>
<td>281</td>
<td>113</td>
<td>394</td>
</tr>
<tr>
<td>Sites</td>
<td>62</td>
<td>55</td>
<td>117</td>
</tr>
<tr>
<td>Bulletin Boards</td>
<td>476</td>
<td>254</td>
<td>500</td>
</tr>
</tbody>
</table>

3.3 PARTICIPANT TRENDS

The number of contributions varies among the participants as would be expected. To examine this trend, participants were categorized into groups based on the level of participation using logarithmic categories (that is, larger ranges are grouped for high participation levels, and smaller ranges for low participation ranges.) This particular grouping crisply displays the skew of participation. The number of participants in each category is plotted with the number of total contributions and the number of total lines of text for that category in Figure 3-1. For example, from the figure we see that users contributing two or three messages constitute about 30 percent of the participants, but only contribute about 17 percent of the traffic in both messages and lines of text.
The number of participants in each category declines as the number of contributions by that category increases. However, the heaviest contributions occur with participants with four to seven contributions each, followed by participants with eight to fifteen contributions each. There is essentially no difference between contributions measured by messages or by lines of text; I will concentrate on messages as the primary unit of contribution for most of this study.

Figure 3-2 has the same data plotted by cumulative contributions by each category of participant; that is, the user count of the 2-3 message category includes users in the 1 message category, the user count of the 4-7 message category includes the users from both the 1 and 2-3 categories, and so forth. From this, we see that about 12 percent of the participants (the top dashed line, with 12 percent being the difference between 100 percent and the marked 88 percent)
generate over 50 percent of the traffic (the lower dashed line).

![Diagram showing cumulative participant distribution across message counts.]

**Figure 3-2: Cumulative Participant Distribution**

The average participant contributes slightly over four messages in a month, totaling over fifty lines of text. His contributions are in 2.4 different electronic bulletin boards. These statistics are detailed in Table 3-2.

**Table 3-2: Average Participant Statistics**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributions</td>
<td>4.13</td>
<td>8.63</td>
</tr>
<tr>
<td>Size of Each</td>
<td>12.27</td>
<td>14.20</td>
</tr>
<tr>
<td>Total Lines of Text</td>
<td>50.71</td>
<td>93.10</td>
</tr>
<tr>
<td>Bulletin Boards</td>
<td>2.40</td>
<td>3.41</td>
</tr>
</tbody>
</table>
3.4 BULLETIN BOARD COMMUNICATION STARS

The variance in participation implies that frequent participants can be identified as a special group for study. Frequent participants are referred to as communication stars in this study, and are defined to be participants with activity level greater than one standard deviation over the mean level of participation. Persons not meeting the star definition will be referred to as communication non-stars.

From the information in Table 3-2, a communication star would have at least thirteen (13) contributions in October, or roughly one every other work day. With this definition of a star, Table 3-3 summarizes the participation levels for stars and non-stars for a month. Referring back to Figure 3-2, note that the stars make up less than six percent of the users, but generate over a third of the messages.

Table 3-3: Star Participation

<table>
<thead>
<tr>
<th></th>
<th>Star</th>
<th>Non-Star</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lines of Text</td>
<td>35,663</td>
<td>73,167</td>
<td>108,830</td>
</tr>
<tr>
<td>Contributions</td>
<td>3,280</td>
<td>5,587</td>
<td>8,867</td>
</tr>
<tr>
<td>Participants</td>
<td>123</td>
<td>2,023</td>
<td>2,146</td>
</tr>
</tbody>
</table>

The typical star makes over 26 contributions a month into over eleven different bulletin boards. This average activity level of at least one contribution per work day yields nearly three hundred lines of text added per month per star. The statistics for a typical star for a month are shown in Table 3-4.
Table 3-4: Average Star Statistics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributions</td>
<td>26.67</td>
<td>25.68</td>
</tr>
<tr>
<td>Size of Each</td>
<td>10.87</td>
<td>11.51</td>
</tr>
<tr>
<td>Total Lines of Text</td>
<td>289.94</td>
<td>233.49</td>
</tr>
<tr>
<td>Bulletin Boards</td>
<td>11.09</td>
<td>9.50</td>
</tr>
</tbody>
</table>

A majority of the stars are located in the United States, as shown in Table 3-5. The trend toward domestic stars is slightly significant (chi squared test, $p < .10$).

Table 3-5: Location Distribution of Stars

<table>
<thead>
<tr>
<th></th>
<th>Domestic</th>
<th>Foreign</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star</td>
<td>110</td>
<td>13</td>
</tr>
<tr>
<td>Non-Star</td>
<td>1671</td>
<td>352</td>
</tr>
</tbody>
</table>

3.5 ELECTRONIC BULLETIN BOARD ACTIVITY

Next, activity in the electronic bulletin boards is examined. Table 3-6 summarizes the monthly activity for the average electronic bulletin board. As seen from the table, there is a wide distribution of numbers of contributions and participants.

Table 3-6: Average Bulletin Board Statistics

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contributions</td>
<td>17.73</td>
<td>39.33</td>
</tr>
<tr>
<td>Size of Each</td>
<td>12.27</td>
<td>14.20</td>
</tr>
<tr>
<td>Total Lines of Text</td>
<td>217.66</td>
<td>449.67</td>
</tr>
<tr>
<td>Participants</td>
<td>10.32</td>
<td>19.73</td>
</tr>
</tbody>
</table>
To better understand the subjects covered in the electronic bulletin boards, each bulletin board was classified by content. The classification categories established were:

**Hardware**, relating to a specific hardware product;

**Software**, relating to a specific software product;

**Technical**, relating to a general technical subject, such as math problems, power surges, and telecommunications protocols;

**Concept**, relating other subjects to the use of computers, such as assistance for blind or handicapped users, educational potential, usefulness of computer games as leading edge applications, and science fiction as an idea source;

**Non-Technical**, relating to a general non-technical subject, such as price information and equipment trading; and

**Locator**, relating to finding information in other bulletin boards, including such meta-bulletin-boards as "WHEREIS", "ISTHERE", and "WISHLIST".

In general, all but the Non-Technical and the Locator bulletin boards address technical subjects; the Locator bulletin board has mixed content. Table 3-7 indicates both the number of bulletin boards in each category and the average number of contributions in messages for each type. Note that four bulletin boards could not be located later during the classification process; their light use apparently lead to their elimination.
Table 3-7: Classification of Bulletin Boards

<table>
<thead>
<tr>
<th></th>
<th>Number</th>
<th>Percent</th>
<th>Average Contrib</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardware</td>
<td>81</td>
<td>16.2%</td>
<td>25.16</td>
</tr>
<tr>
<td>Software</td>
<td>312</td>
<td>62.4%</td>
<td>12.48</td>
</tr>
<tr>
<td>Technical</td>
<td>43</td>
<td>8.6%</td>
<td>26.67</td>
</tr>
<tr>
<td>Concept</td>
<td>27</td>
<td>5.4%</td>
<td>31.67</td>
</tr>
<tr>
<td>Non-Technical</td>
<td>28</td>
<td>5.6%</td>
<td>15.18</td>
</tr>
<tr>
<td>Locator</td>
<td>5</td>
<td>1.0%</td>
<td>98.40</td>
</tr>
<tr>
<td>Missing</td>
<td>4</td>
<td>0.8%</td>
<td>4.00</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>500</td>
<td>100.0%</td>
<td>17.73</td>
</tr>
</tbody>
</table>

While Locator electronic bulletin boards seem more active than average as users seek information, it is not statistically significant (t-test, t = 1.229). However, Concept electronic bulletin boards are relatively active (t-test, p < 0.05) and seem to draw users into discussions with no immediate product impact. On the other hand, Software bulletin boards are relatively inactive (t-test, p < 0.0005), which is probably due to the large number of small bulletin boards on specialized program offerings.

3.6 BULLETIN BOARD TRENDS

As would be expected, the size (in message contributions) of the electronic bulletin boards varies widely. Indeed, ninety-five (95) bulletin boards had only a single contribution in October. Bulletin boards were categorized into groups based on the level of contributions using logarithmic categories (again, to emphasize the contribution skew). The number of bulletin boards in each category is plotted with the number of total contributions and the number of total lines of text for that category in Figure 3-3.
The number of electronic bulletin boards in each category rapidly declines as the number of contributions by that category increases. However, the heaviest contributions occur in bulletin boards with about thirty to sixty contributions (1.5 to 3 per work day), with even larger bulletin boards a close second in volume. As was the case for participants, there is no clear distinction between counting contributions and counting total lines of text; I will use contributions for the most part in the remainder of the study.

Figure 3-4 has the same data plotted by cumulative contributions by each category of bulletin board. From this, we can readily see that about 23 percent of the electronic bulletin boards (the top dashed line, representing 100 percent minus 88 percent) contain nearly 80 percent of the contributions (the lower dashed line).
Finally, contribution tendencies for electronic bulletin boards were explored. In particular, are larger bulletin boards frequented by proportionally fewer users, with each user making more contributions? I would suspect so.

To test this hypothesis, the size (in messages) and the number of unique participants were extracted for each bulletin board which is larger than average (at least 18 messages). The average number of messages per user was calculated for each bulletin board, and the bulletin boards ranked in size (count of messages). A Spearman's rank correlation between the growing size of a bulletin board and the average messages per participant was calculated. The plot of the data is shown in Figure 3-5. It can be seen visually that a very mild trend toward heavier individual participation in larger bulletin boards exists, but not nearly to the extent I suspected. The Spearman's rho of 0.420 is significant at less than 0.0001.
3.7 SUBGROUP COMMUNICATION MECHANISM

One final point can be explored with the data collected on these electronic bulletin boards. Are there particular bulletin boards which draw especially heavy participation from subsets of the participants? I will examine three significant sub-groups: stars, non-stars, and foreign participants.

Star Bulletin Boards

First, electronic bulletin boards with the heaviest star participation were identified from the set of bulletin boards of larger than average size (at least 18 messages). The bulletin boards with the highest percentage of star contributions are listed in Table 3-8 with a brief description of the bulletin board subject, the size of the bulletin board in messages, and the percentage of those messages from stars.
Table 3-8: High Star Participation Bulletin Boards

<table>
<thead>
<tr>
<th>Msg Count</th>
<th>Star %</th>
<th>Bulletin Board Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 60</td>
<td>87%</td>
<td>Network Tool Distribution</td>
</tr>
<tr>
<td>2. 142</td>
<td>85%</td>
<td>Bulletin Board Maintenance</td>
</tr>
<tr>
<td>3. 40</td>
<td>78%</td>
<td>Computer Information Security</td>
</tr>
<tr>
<td>4. 41</td>
<td>73%</td>
<td>Program Package Reviews</td>
</tr>
<tr>
<td>5. 65</td>
<td>72%</td>
<td>Advanced Microprocessor Use</td>
</tr>
<tr>
<td>6. 29</td>
<td>69%</td>
<td>ANSI Standards for C (a Language)</td>
</tr>
<tr>
<td>7. 25</td>
<td>68%</td>
<td>Modula2 (Another Language)</td>
</tr>
<tr>
<td>8. 25</td>
<td>68%</td>
<td>Distributed Operating Systems</td>
</tr>
<tr>
<td>9. 54</td>
<td>63%</td>
<td>Sensitivity in Bulletin Boards</td>
</tr>
<tr>
<td>10. 112</td>
<td>63%</td>
<td>Utilities to Check Computer Configurations</td>
</tr>
<tr>
<td>11. 91</td>
<td>59%</td>
<td>Bulletin Board Review Criteria</td>
</tr>
</tbody>
</table>

The top two bulletin boards were meta-subject bulletin boards, addressing the maintenance of the electronic bulletin board system itself. The ninth ranked bulletin board addresses the necessary sensitivity to others which should be observed in contributions to the bulletin boards. And the eleventh ranked bulletin board addresses the bulletin board topic mores, for example which subjects can be discussed (breaking a product's copy protection cannot be discussed) and what type of criticisms are allowed (nothing personal). The prevalence of this type of bulletin board with heavy star participation leads me to suspect that the frequent users are the owners of bulletin boards, or at least establish the mores for participation.

Also among the top ten bulletin boards are two programming language bulletin boards, a bulletin board on a complex distributed programming environment, and a bulletin board on programming a new, advanced microprocessor. These bulletin boards lead me to suspect that the stars are expert programmers.
The hypotheses that stars are bulletin board owners and expert programmers will be explored further in this study when a survey of participants is analyzed.

**Non-Star Bulletin Boards**

Again drawing from the electronic bulletin boards which are larger than average, the bulletin boards with the lowest star participation (i.e., highest non-star participation) were extracted from the data base. Table 3-9 lists these bulletin boards in increasing order of participation percentage for stars, with a brief description of the subject.

**Table 3-9: Low Star Participation Bulletin Boards**

<table>
<thead>
<tr>
<th>Msg Count</th>
<th>Star %</th>
<th>Bulletin Board Subject</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. 38</td>
<td>3%</td>
<td>Address Label Maintenance Program</td>
</tr>
<tr>
<td>2. 47</td>
<td>4%</td>
<td>Music Printing Program</td>
</tr>
<tr>
<td>3. 22</td>
<td>5%</td>
<td>An Operating System Discussion</td>
</tr>
<tr>
<td>4. 55</td>
<td>7%</td>
<td>High Resolution Graphics Terminal</td>
</tr>
<tr>
<td>5. 24</td>
<td>8%</td>
<td>Music Generation Hardware</td>
</tr>
<tr>
<td>6. 22</td>
<td>9%</td>
<td>Pop-up Note Utility</td>
</tr>
<tr>
<td>7. 21</td>
<td>10%</td>
<td>Competitive Equipment Discussion</td>
</tr>
<tr>
<td>8. 20</td>
<td>10%</td>
<td>Print Enhancement Utility</td>
</tr>
</tbody>
</table>

Notable in this list are several utilities which this audience is seeking advise (address labels, pop-up note pads, print enhancement). Non-stars would seem to be more interested in getting assistance with tools to enable them to function more efficiently in their current jobs. This thought, however, must be contrasted with an interesting fascination with computer music management (two bulletin boards).
One final interesting bulletin board is the Who's Who directory, allowing electronic bulletin board participants to register personal information on themselves to "facilitate communication with other participants," claims the introduction. Stars being noticeably quiet in their use of this bulletin board may suggest that they prefer to remain anonymous, and perhaps personally select the subjects with which to get involved; or the stars may avoid registration simply to eliminate nuisance direct queries. On the other hand, they may simply have registered years ago and need not register again.

**Foreign Participant Bulletin Boards**

The electronic bulletin boards with high foreign participation percentages were also examined. There was but a single noteworthy bulletin board, one specifically addressing differences in computer products available in non-US countries. The remaining active bulletin boards addressed program products which have just been released in foreign countries, with bulletin board participants exploring installation and foreign language problems.

3.8 CONCLUSIONS

Before moving on, a quick summary of the observed results is appropriate.

1. **Large variations in the level of participation of individuals are observed.** While the number of active participants is large, a small percentage accounts for most of the traffic.
2. **Large variations in the level of participation in individual bulletin boards are observed.** Even to a larger extent than the skew for individuals, a rather small number of electronic bulletin boards account for most of the activity.

3. **Most bulletin board subjects are technical, with a predominance of programming subjects.**

4. **Only a slight trend toward specialization occurs in larger bulletin boards.** The average contributions per participant rises only slightly from the moderate size bulletin boards to the very largest bulletin boards.

5. **Stars seem to influence the development and operation of the bulletin board system.** Electronic bulletin boards dealing with control and operation show extremely high levels of star participation.

6. **Stars seem to be expert programmers.** Again, this is asserted based on the high levels of participation in bulletin boards dealing with advanced programming environments. In contrast, non-stars dominate bulletin boards dealing with certain productivity tools.
CHAPTER 4: COMMUNICATION PATTERNS

4.1 EXPECTED COMMUNICATION PATTERNS

Below, some hypotheses are stated concerning the bulletin board subjects and the dynamics of bulletin board use by different groups. These hypotheses guide our explorations of the bulletin board system in the second phase of the study.

I expect electronic bulletin boards to reflect technical exchanges on the subjects covered. This would be in keeping with the number of technical subjects covered by electronic bulletin boards in comparison with the few administrative subjects. Thus:

Hypothesis 4-1: The majority of bulletin board communications will address technical subjects.

In the previous chapter, stars in the electronic bulletin board system were identified, and it was noted that they contributed a significant portion of the bulletin board system's traffic. If the role stars play in the network is similar to that in other informal communication networks, the stars may be acting as a group resource of expertise, providing proportionally more information in the form of answers to questions than non-stars.

Hypothesis 4-2: A higher proportion of messages from stars (versus non-stars) will be answers.

Stars may also tend to manage the electronic bulletin boards, and hence may have more administrative or non-technical exchanges. On the other hand, this should be mitigated by their higher technical interest and the tendency of non-stars to put non-technical questions into the electronic bulletin board without understanding an underlying
technical culture to which the stars are part. A metric for this tendency would be a comparison of the proportion of technical contributions as a percentage of all contributions. Hence:

**Hypothesis 4-3**: Stars and non-stars will not differ in their proportion of technical contributions.

Trends are also possible for participants based on whether they are located in the U.S. or elsewhere. In the previous chapter, one result was that there are proportionally more domestic stars than foreign stars. After compensating for that trend, are there more questions from foreign participants than domestic participants? I would suspect not. Hence:

**Hypothesis 4-4**: Foreign non-stars and domestic non-stars do not differ in the proportion of questions and answers.

Similarly, I would expect no difference on the basis of technical contributions. Hence:

**Hypothesis 4-5**: Foreign participants and domestic participants do not differ in proportion of technical contributions.

Finally, the network is essentially distance independent since all messages are routed to the master conference machine and then distributed to shadow conference disks around the world. I would expect to see no pattern by site or machine between the asker of a question and the responder. Hence:

**Hypothesis 4-6**: There is no correlation between the locations of the asker and responder.
4.2 TECHNIQUE FOR TESTING: SAMPLE AND ANALYZE

To begin to address some of these theories, a sample of 196 of the 8867 messages was classified. Three major classifications were made for each message:

- Question or answer
- Technical or non-technical subject
- Demographics of the corresponding question or answer (if any) to this message

Each of these categories deserves further explanation.

**Question or Answer Category**

Each message was classified as to whether it was a question, an answer, or dictum. A dictum is a message which simply adds knowledge to an electronic bulletin board or states an opinion. Some messages were no longer in the electronic bulletin board -- electronic bulletin boards are periodically edited to keep their size reasonable. Such messages were marked as missing.

Since the average message was brief, messages could be easily classified without ambiguity. Whenever a message contained both a question and an answer, it was classified based on whichever (question or answer) was first. Since in the same message an answer to a prior message's question tends to precede the asking of a question in this message, I do not estimate the absolute number of questions and answers from the sample, but rather draw conclusions comparing the proportion of questions and answers for relevant groups. Any surrounding dictum was ignored when seeking the question or answer for classification purposes.

**Technical or Non-Technical Subject**

The messages were further classified as to the nature of their content. If a message dealt with a technical subject,
it was classified as such. Messages on administrative matters were classified as non-technical.

Some of the characteristics which were used in classification of the technical message are:

- Hardware subject
- Existence of a package to perform a task
- Program incompatibilities
- Software errors (or bugs)

This list details some of the characteristics of administrative, or non-technical, messages:

- Price of products, programs, or features
- Availability of same
- Acquisition procedures of same
- Announcements of the existence of same (unsolicited)
- Electronic bulletin board control and procedure discussions

While the classification does leave some room for discretion when selecting the category, in practice such discretion was rarely required.

Demographics on Matching Questions and Answers

For each message classified as a question or an answer, an effort to find the corresponding message (answer or question) was made. At least fifteen messages around each message were searched before concluding that there was no corresponding message. For questions, this implies that there was no electronic bulletin board answer, though it does not preclude the originator of the message receiving a direct reply in person, by phone, or most likely by a direct electronic mail message not passing through a bulletin board. Indeed, some questions specifically asked for such direct replies, such as the solicitation of interest in swapping spare equipment.
Statistical Significance Testing

For the data in this chapter, analysis will be done to see if trends exist by testing the hypothesis that the distribution would not be random. Unless otherwise noted, a chi-squared test is used since the sample size fits nicely to that test. If a trend is deemed significant, the possibility of a type I error is noted with that trend, and is expressed as a probability (p < some fraction). For example, (p < .05) means that the probability of the noted distribution occurring randomly is less than five percent.

For small samples, a Fisher Exact Test is used to determine the exact probability of the particular distribution or a more extreme distribution occurring.

4.3 SAMPLING RESULTS

The one hundred, ninety-six (196) sampled messages were scanned and classified. The message count by origin and star classification is shown in Table 4-1 below.

<table>
<thead>
<tr>
<th></th>
<th>Domestic</th>
<th>Foreign</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star</td>
<td>78</td>
<td>6</td>
<td>84</td>
</tr>
<tr>
<td>Non-Star</td>
<td>98</td>
<td>14</td>
<td>112</td>
</tr>
<tr>
<td>Total</td>
<td>176</td>
<td>20</td>
<td>196</td>
</tr>
</tbody>
</table>

Overall Classification Totals

Of the one hundred, ninety-six messages, there were twenty-six (26) which could not be located; these messages had been edited from the bulletin board by the owner as part of the continuing effort to reduce bulletin board size. The remaining were classified with the following totals summarized below.
Table 4-2: Classifications of 170 Messages

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Question</td>
<td>59</td>
<td>34.7%</td>
</tr>
<tr>
<td>Answer</td>
<td>67</td>
<td>39.4%</td>
</tr>
<tr>
<td>Dictum</td>
<td>44</td>
<td>25.9%</td>
</tr>
<tr>
<td>Technical</td>
<td>130</td>
<td>76.5%</td>
</tr>
<tr>
<td>Non-Technical</td>
<td>40</td>
<td>23.5%</td>
</tr>
</tbody>
</table>

More technical messages exist than non-technical messages, reflecting the large number of technical topics enumerated in the previous chapter. The number of non-technical messages (over 23%) seems large considering the small proportion of non-technical electronic bulletin boards (7.4%), but recall that license questions, electronic bulletin board admonitions against confidential information, and software package announcements are counted as non-technical exchanges.

The rather even split between questions and answers confirms my earlier speculations that an electronic bulletin board is used as a communications vehicle for technical problems and solutions. I will return to this topic later in this chapter when the correlations of questions and answers is discussed.

The rather large message count in the dictum category reflects unsolicited contributions. A typical contribution might discuss a tricky printer setup problem and the solution developed by the single individual. The contributor seems motivated to make this information generally available to electronic bulletin board readers. These motivations are investigated further in the participant survey.
Message counts by technical and question/answer classifications are shown in Table 4-3. Several interesting observations can be made.

Table 4-3: Technical - Q/A

<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Answer</th>
<th>Dictum</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>47</td>
<td>61</td>
<td>22</td>
<td>130</td>
</tr>
<tr>
<td>Non-Technical</td>
<td>12</td>
<td>6</td>
<td>22</td>
<td>40</td>
</tr>
<tr>
<td>Total</td>
<td>59</td>
<td>67</td>
<td>44</td>
<td>170</td>
</tr>
</tbody>
</table>

The types of message in the technical category differ significantly from those that are non-technical (p < .005). In particular, there are fewer non-technical answers than expected (six versus expected 15.8). Non-technical questions seem to be lacking responses.

Also, there are many more non-technical dicta than expected (22 versus expected 10.4). However, since bulletin board control messages and program availability announcements were counted as non-technical, the particular split is not surprising.

Multiple contributors seem to express their opinions to a single technical question. This latter point is explored later in this chapter when the data on matching questions and answers are analyzed.

Stars as Information Resources

The star classification was cross referenced with the question/answer classification, with the following results (Table 4-4).
Table 4-4: Star - Q/A

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Dictum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star</td>
<td>16</td>
<td>30</td>
</tr>
<tr>
<td>Non-Star</td>
<td>43</td>
<td>37</td>
</tr>
</tbody>
</table>

The difference in the types of messages for stars and non-stars is significant (p < .005). The stars ask far fewer questions than expected (16 versus expected 25.3), and are more prone to insert opinions and unsolicited information into the electronic bulletin board than are non-stars (27 dicta versus expected 18.9). This is an indication that stars are serving as information providers to a larger degree than non-stars.

Location Determining Information Provision

When the types of messages are cross-referenced with the location (U.S. or not) of the contributor, no significant difference exists in the distribution of message types. (There were 26 messages which could not be located for classification, all from domestic participants.)

Table 4-5: Location - Q/A

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Dictum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>49</td>
<td>62</td>
</tr>
<tr>
<td>Foreign</td>
<td>10</td>
<td>5</td>
</tr>
</tbody>
</table>

However, recall that the sample has a high proportion of domestic stars with their significant distribution skews. To remove the bias for the higher number of stars in the domestic locations, Table 4-6 reflects the questions and answers for non-stars for both the domestic and foreign participants.
Table 4-6: Non-Stars, by Location - Q/A

<table>
<thead>
<tr>
<th>Location</th>
<th>Question</th>
<th>Answer</th>
<th>Dictum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>33</td>
<td>35</td>
<td>15</td>
</tr>
<tr>
<td>Foreign</td>
<td>10</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

With the stars removed, there is a slight statistical difference between the non-star domestic participants and the non-star foreign participants (p < .10): Foreign participants are asking more questions than expected (ten versus expected 6.2) and answering fewer questions (two versus expected 5.3).

There are several possible explanations. Time zone differences allow domestic responses to questions to appear quicker in the electronic bulletin boards; a potential foreign respondent may wait a day for an answer to appear before volunteering his own (potentially duplicate) reply. Difficulties with phrasing precise technical English language answers for participants whose native language is not English may inhibit the incentive to reply. Finally, the Personal Computer revolution is moving more slowly in foreign countries than here, and there may simply not be the expertise in the "leading edge" topics on which to base an answer.

Domestic Stars as Information Providers

The large "question" influence of foreign participants causes me to reexamine the "star as information provider" theory once more, with only domestic participants examined. Table 4-7 reflects the questions, answers, and dicta for domestic participants, segregated by the star classification.
Table 4-7: Domestic Only by Star - Q/A

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Dictum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star</td>
<td>16</td>
<td>27</td>
</tr>
<tr>
<td>Non-Star</td>
<td>33</td>
<td>35</td>
</tr>
</tbody>
</table>

There still appears a significant difference between the message mix for stars and non-stars (p < .025), though not quite to the degree found before. Domestic non-stars are placing more answers in the bulletin boards than questions. But the stars still ask fewer questions than expected (16 versus 21.9) and inject much more dicta than expected (24 versus 17.4).

Foreign Stars as Information Providers

Similarly, I am curious about the foreign participants and the proportion of questions and answers for foreign stars and foreign non-stars. Table 4-8 has the data from the sample on this point. Though the small number of messages from foreign stars is small, the possibility of a distribution this extreme is 2.20% (Fisher Exact Test), again reinforcing the significant trend toward stars being information providers.

Table 4-8: Foreign Only by Star - Q/A

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
<th>Dictum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Non-Star</td>
<td>10</td>
<td>2</td>
</tr>
</tbody>
</table>

Technical Information Trends in Stars

Now let me move from the question/answer classifications to the technical/non-technical classifications. In the beginning of this chapter, I hypothesized no difference between the proportion of technical messages (as a percentage
of total contributions) for stars and non-stars. Table 4-9 summarizes the data from the sample.

**Table 4-9: Star - Technical**

<table>
<thead>
<tr>
<th></th>
<th>Technical</th>
<th>Non-Technical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star</td>
<td>54</td>
<td>19</td>
</tr>
<tr>
<td>Non-Star</td>
<td>76</td>
<td>21</td>
</tr>
</tbody>
</table>

The proportion of technical contributions is nearly identical for both stars and non-stars; there is no significant difference between the distributions. Removing the foreign participants and simply checking the domestic trends yields the same result (Table 4-10), namely that there is no significant difference.

**Table 4-10: Domestic by Star - Technical**

<table>
<thead>
<tr>
<th></th>
<th>Technical</th>
<th>Non-Technical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star</td>
<td>50</td>
<td>17</td>
</tr>
<tr>
<td>Non-Star</td>
<td>64</td>
<td>19</td>
</tr>
</tbody>
</table>

There is insufficient data in my sample to address any foreign participant patterns for proportion of technical contribution based on star classifications.

**Location Trends on Technical Contributions**

I hypothesized no trend on the proportion of technical contributions based on location. Table 4-11 and Table 4-12 give the data from the sample for the entire population classified by location, and for the non-star population classified by location, respectively.
Table 4-11: Location - Technical

<table>
<thead>
<tr>
<th></th>
<th>Technical</th>
<th>Non-Technical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>114</td>
<td>36</td>
</tr>
<tr>
<td>Foreign</td>
<td>16</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 4-12: Non-Stars by Location - Technical

<table>
<thead>
<tr>
<th></th>
<th>Technical</th>
<th>Non-Technical</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic</td>
<td>64</td>
<td>19</td>
</tr>
<tr>
<td>Foreign</td>
<td>12</td>
<td>2</td>
</tr>
</tbody>
</table>

In each case, there is no statistically significant trend toward either domestic participants or foreign participants having a higher proportion of technical contributions.

Question and Answer Correlation: Missing Answers

Of the fifty-nine (59) questions in the sample, twenty-four (24) had no answers detectable in the electronic bulletin board itself. This number is not surprising for, as mentioned above, many questions solicited direct answers to the inquiry (by phone or direct electronic message not through the bulletin board); the asker obviously felt the answer to the question was not of general interest and hence not appropriate for the bulletin board. Examples seen in this sample were a solicitation for an equipment exchange ("anyone interested in swapping an X for a Y?") or a request for direct transmission of a missing software package ("I lost my copy of a print utility; can someone send me electronically ...?").

Are any biases with questions without electronic bulletin board resident answers, whether by location, role, or type of question? Table 4-13 shows the various breakdowns for the questions which did not receive an answer, including the actual number and the percentage of all messages in the
category that number represents. The categories include the type of question (technical or non-technical) and who asked the question (star or non-star, domestic or foreign participant).

Table 4-13: Unanswered Question Classification

<table>
<thead>
<tr>
<th></th>
<th>Total Number</th>
<th>Answer Missing</th>
<th>Percentage Missing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>47</td>
<td>16</td>
<td>34.0%</td>
</tr>
<tr>
<td>Non-technical</td>
<td>12</td>
<td>8</td>
<td>66.7%</td>
</tr>
<tr>
<td>Star</td>
<td>16</td>
<td>7</td>
<td>43.8%</td>
</tr>
<tr>
<td>Non-star</td>
<td>43</td>
<td>17</td>
<td>39.5%</td>
</tr>
<tr>
<td>Domestic</td>
<td>49</td>
<td>20</td>
<td>40.8%</td>
</tr>
<tr>
<td>Foreign</td>
<td>10</td>
<td>4</td>
<td>40.0%</td>
</tr>
</tbody>
</table>

Examining each category, there is no statistical bias in not answering questions.

Question and Answer Correlation: Missing Questions

As well as questions which seem to have gone unanswered in the electronic bulletin boards, there were eight (8) answers for which the question could not be found. While there could have been a classification error in the sample, many of these answers clearly referenced a previously asked question. Table 4-14 shows the classifications for these answers without questions. Since there are only a small number of these answers, and there appears to be no bias in their classification, I do not consider these missing answers to significantly influence my next analysis.
Table 4-14: Classification of Answers without Questions

<table>
<thead>
<tr>
<th></th>
<th>Total Number</th>
<th>Number Missing</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical</td>
<td>61</td>
<td>7</td>
<td>11.4%</td>
</tr>
<tr>
<td>Non-technical</td>
<td>6</td>
<td>1</td>
<td>16.7%</td>
</tr>
<tr>
<td>Star</td>
<td>30</td>
<td>4</td>
<td>13.3%</td>
</tr>
<tr>
<td>Non-star</td>
<td>37</td>
<td>4</td>
<td>10.8%</td>
</tr>
<tr>
<td>Domestic</td>
<td>62</td>
<td>8</td>
<td>12.9%</td>
</tr>
<tr>
<td>Foreign</td>
<td>5</td>
<td>0</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

Question and Answer Correlation: Same Site

At the beginning of this chapter, I hypothesized that due to the uniform delay of participation without regard to geography there would be no geographic relationship between the asker of a question and the responder. From my sample, I selected the thirty-five (35) questions with identifiable answers and the fifty-nine (59) answers with identifiable initiating questions, for a total of ninety-four (94) pairs of questions and answers.

There are two possible measures of geographic relationships. For each user, his site location is known. However, since sites are often quite large (several thousand users), there would be a slim chance that the users at the same site may actually work together or even know each other. Yet users located quite close to each other, and certainly users working on the same project, are assigned user identifications on the same computer nodes. My data base contains both site and computer node information.

For my set of messages, the exact probabilities for zero, one, two, etc. message pairs from the same node and site were calculated. A five percent threshold was established for
testing the message pairs; if there is less than a five percent probability that a particular coincidence of node or site correlation occurring, the hypothesis of no local bias will be rejected. For the test for node bias, at least four (4) message pairs must share the same node; for site bias, at least seven (7) message pairs must share the same site. Table 4-15 shows the actual number of pairs with the same computer node and the same site.

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Observed</th>
<th>5% Threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td>Same Node</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Same Site</td>
<td>13</td>
<td>7</td>
</tr>
<tr>
<td>Same User</td>
<td>8</td>
<td>--</td>
</tr>
<tr>
<td>Node, w/o User</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Site, w/o User</td>
<td>5</td>
<td>7</td>
</tr>
</tbody>
</table>

While at first glance there was a significant correlation in both sites and nodes, there are eight questions which were answered by the originator of the question! Most of the answers were summaries of the solutions to the originally posed problems, or the results of trying the suggestions received either through the electronic bulletin board or directly through other communications. This seems to reflect powerful electronic bulletin board mores of having the answer to a question of general interest appear in the electronic bulletin board. From personal experience, direct queries may be received by the originator months after the original question if an answer to the question is not in the bulletin board. Users, sensing this trend, would be encouraged to register the final answer in the electronic bulletin board.

Eliminating the self-answered questions, the count of message pairs with the same node or site are within the thresholds; therefore, no significant geographic relationship
exists between the questioner and the responder, as is reflected in the last two entries in Table 4-15.

**Question and Answer Correlation: Subnetworks of Stars**

One final tidbit can be gleaned from this sample. Stars may tend to respond better to questions from stars, leaving the non-stars to fend for themselves. This could be a natural segregation based on experience rather than a conscious activity.

One sign that there are such subnetworks is that questions by stars will tend to be answered by stars, and similarly non-stars will be left to respond to questions of other non-stars. Table 4-16 is the matrix of question source (star or not) and answer source (star or not). Drawing from Table 4-4 the probability of a star answer (30 of 67 answers), the pattern of answers is a nearly perfect match for the expected random pattern (the random expected values are shown in parentheses in Table 4-16). Hence, there is no apparent subnetwork of stars using the bulletin board system for communication.

<table>
<thead>
<tr>
<th>Questions From:</th>
<th>Answers From:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Star</td>
<td>Star</td>
</tr>
<tr>
<td>13 (13.0)</td>
<td>16 (16.0)</td>
</tr>
<tr>
<td>30 (29.1)</td>
<td>35 (35.9)</td>
</tr>
</tbody>
</table>

**4.4 CONCLUSIONS**

Before moving on, a quick summary of the observed results is appropriate.
1. **Most communication is on technical subjects.** (Supports hypothesis 4-1.)

2. **Stars are information providers to the participants in general.** They supply proportionally more answers than questions when compared to non-stars. Further, stars also inject significantly more unsolicited information messages (dicta) than do non-stars. (Supports hypothesis 4-2.)

3. **There is no difference in non-stars based on being domestic or foreign participants.** (Supports hypothesis 4-4.)

4. **There is no distinction based on proportion of technical contributions by any group (foreign vs. domestic; stars vs. non-stars).** (Supports hypotheses 4-3 and 4-5.)

5. **There is no geographic correlation between question asker and question responder.** (Supports hypothesis 4-6.)

6. **Self-answered questions indicate electronic bulletin board mores to provide answers to questions of general interest in the electronic bulletin board itself.**

7. **There is no pattern to questions and answers suggesting a subnetwork among stars.**
CHAPTER 5: CONTRIBUTOR SURVEY

5.1 SURVEY TECHNIQUE

To probe deeper into the characteristics of the contributors to the electronic bulletin board system, a survey was taken. Each survey questionnaire was coded as to whether it was sent to a star (a contributor of at least thirteen messages in October 1986) or a non-star. The survey was distributed only to United States participants to (1) ensure timely reply and (2) ensure no ambiguity of the questions to persons without English as their native language.

The selection of the survey sample population was as follows. First, the network locations of all domestic stars were extracted from the data base, along with a random sample of one hundred domestic non-stars. Then based on the network location, the physical address of each survey candidate was sought in an on-line corporate phone directory system. About 80 percent of the star addresses were successfully located, and 84 percent of the non-star addresses. About 85 percent of the surveys were returned by each group. This data is summarized in Table 5-1.

<table>
<thead>
<tr>
<th>Table 5-1: Survey Demographics</th>
<th>Star</th>
<th>Non-Star</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Domestic</td>
<td>110</td>
<td>100</td>
</tr>
<tr>
<td>Addresses Found</td>
<td>89</td>
<td>84</td>
</tr>
<tr>
<td>Location Rate</td>
<td>80.9%</td>
<td>84.0%</td>
</tr>
<tr>
<td>Surveys Returned</td>
<td>77</td>
<td>71</td>
</tr>
<tr>
<td>Response Rate</td>
<td>86.5%</td>
<td>84.5%</td>
</tr>
</tbody>
</table>

71
5.2 SURVEY HYPOTHESES

From the indications of the bulletin board classifications and the sampling results in the previous chapters, several hypotheses are stated as to the results of the survey.

Since the majority of subjects are related to software, my first hypothesis is:

Hypothesis 5-1: Stars will tend to have stronger programmer backgrounds.

Since an electronic bulletin board system is relatively free of social cues (see Chapter 2), contributors will tend to be self-centered. In particular, they will see their own contributions as more frequent than supporting data will indicate. Hence:

Hypothesis 5-2: Both stars and non-stars will overstate their levels of contributions to the bulletin board system, both in number of total contributions and different bulletin boards to which contributions have been made.

Participants will attempt to retain the social distance (lack of social cues) in their use of the bulletin board system. Their communication will be primarily through the bulletin board itself, or at least through direct electronic mail. Hence:

Hypothesis 5-3: Most answers to questions will flow through the bulletin board system itself, or will be received by direct electronic response (as opposed to a phone call or face-to-face exchange).

A frequent users should be a happy user. Hence:
**Hypothesis 5-4:** Stars will express more satisfaction with the answers they receive through the bulletin board system than non-stars.

If my designated stars exhibit gatekeeper traits, they will tend to use the bulletin boards to broaden their knowledge. In particular:

**Hypothesis 5-5:** Stars will indicate a stronger personal desire than non-stars to "keep up" or satisfy their curiosity on bulletin board subjects.

**Hypothesis 5-6:** Stars will indicate a stronger personal desire to help others as a motivation for participation.

Since the electronic bulletin board system is a rich source of information, those persons with job responsibilities related to its subjects should be among the frequent contributors. Hence:

**Hypothesis 5-7:** Stars will have a higher proportion of job assignments related to the bulletin board system topics than non-stars.

The bulletin board system serves as an expert locator. While the literature suggests that electronic mail serves as reinforcement for relationships established by other means, I hypothesize that a large number of new contacts are made through the bulletin board, and are subsequently used via other means. Hence:

**Hypothesis 5-8:** Most users did not know the people with whom they communicate through the bulletin board system prior to using that medium.
Contribution to any degree in the bulletin board system shows initiative on the part of the contributor. Even infrequent contributors are seeking better ways to do their jobs. Hence:

**Hypothesis 5-9:** No distinction on job performance between stars and non-stars will be discovered.

The low social cost of using bulletin boards should be reflected by a preference for their use in lieu of direct personal contact when problems arise. Also, the accessibility of the information should encourage early use of the bulletin boards. This phenomena is surprisingly common; for example, Rosenberg [1967] demonstrated that the expected amount of information available from a source can be less important than ease of use in determining whether it is selected. Hence:

**Hypothesis 5-10:** In order of consultation, use of bulletin boards will rank high relative to use of direct contact mechanisms.

For frequent users, bulletin boards should also be regarded as a particularly effective vehicle. Hence:

**Hypothesis 5-11:** In order of effectiveness, stars will rate bulletin boards high relative to other information sources.

### 5.3 Survey Respondent Demographics

Several types of demographic information are included in the survey: basic personal information on years with the company, current function, job title, and performance; information on computer familiarity and experience; and, specific information on experience using the electronic bulletin board system. As with the other survey information, each response is coded as a star or non-star answer.
Personal Demographics

No significant difference exists between stars and non-stars on any dimension of personal information. The median respondent has had six to ten years of experience with the company, with the mode being five or fewer years. However, significant numbers of employees with more seniority exist, as seen in Table 5-2. Overall corporate or development demographics on years of service are not available for comparison.

<table>
<thead>
<tr>
<th>Years of Service</th>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>30</td>
<td>28</td>
</tr>
<tr>
<td>6-10</td>
<td>11</td>
<td>13</td>
</tr>
<tr>
<td>11-15</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>16-20</td>
<td>16</td>
<td>10</td>
</tr>
<tr>
<td>21-25</td>
<td>7</td>
<td>12</td>
</tr>
<tr>
<td>&gt; 25</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total Respondents</strong></td>
<td><strong>76</strong></td>
<td><strong>71</strong></td>
</tr>
</tbody>
</table>

Almost all respondents indicate that they work in research or development -- 84.6 percent of stars and 76.2 percent of non-stars. Marketing and manufacturing represent most of the remaining replies.

Only one star and two non-stars indicate they are managers out of 147 valid replies. In research and development, at least ten to fifteen percent of employees are in management, and most of these have technical training. Thus, the absence of managers as participants, even as non-stars, seems significant.

Performance ratings were solicited from the respondents, although an additional notation that the information was optional was included on the questionnaire; privacy of
sensitive information is a strong part of the corporate culture, and the notation was added to encourage a high response rate on the remaining questions. Twenty-four of the 148 respondents chose not to answer the question, the highest non-response rate of any question.

Four satisfactory performance categories are used by the company. The responses for both stars and non-stars are presented in Table 5-3; no statistically significant difference exists between the groups. For stars, the percentage of respondents in the top two categories are slightly higher than corporate averages. However, if non-

<table>
<thead>
<tr>
<th>Performance Rating</th>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superior</td>
<td>10</td>
<td>7</td>
</tr>
<tr>
<td>Exceeds Expectations</td>
<td>42</td>
<td>41</td>
</tr>
<tr>
<td>Exceeds Occasionally</td>
<td>18</td>
<td>5</td>
</tr>
<tr>
<td>Meets Requirements</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>(no answer)</td>
<td>7</td>
<td>18</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>77</td>
<td>71</td>
</tr>
</tbody>
</table>

Another measure of performance is the time between promotions. A recently promoted employee will have a lower performance rating during his early tenure at the new higher position. So while there may be no difference between stars and non-stars on performance ratings, a difference in the length of time since the last promotion will indicate an inherent performance difference. Survey respondents were asked to indicate the time of their last promotion. For
stars, the average time since the last promotion is over three years ago, while non-stars were promoted less than three years ago; however, no statistically significant difference exists. The detailed data are presented below.

Table 5-4: Time in Months Since Last Promotion

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stars</td>
<td>39.7</td>
<td>48.9</td>
</tr>
<tr>
<td>Non-Stars</td>
<td>32.2</td>
<td>32.5</td>
</tr>
</tbody>
</table>

Computer Experience of Respondents

The survey also probed the degree of computer experience of the respondents, again for both stars and non-stars. Table 5-5 presents the number of years respondents have used computers. Clearly, the average number of years of use exceeds years of service with the company (compare to Table 5-2); most respondents had experience in college or in prior jobs. Hence, these respondents will not be particularly reluctant to use computers in a new fashion, electronic bulletin boards in this case. No significant difference exists between stars and non-stars on this measure.

Table 5-5: Distribution of Years Using Computers

<table>
<thead>
<tr>
<th>Years</th>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>1-5</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>6-10</td>
<td>15</td>
<td>18</td>
</tr>
<tr>
<td>11-20</td>
<td>26</td>
<td>26</td>
</tr>
<tr>
<td>&lt; 20</td>
<td>27</td>
<td>20</td>
</tr>
</tbody>
</table>

When queried as to their skills as computer users, respondents consider themselves "expert" (46 percent stars, 31
percent non-stars) or "quite knowledgeable" (43 percent stars, 50 percent non-stars). Only one person (a non-star) considers himself an "inexperienced" computer user. No significant difference exists between stars and non-stars.

However, when queried as to their skills as programmers, stars consider themselves as stronger programmers than non-stars (chi-squared test, p < .05). Table 5-6 summarizes the skill distribution. In particular 83 percent of the stars consider themselves "experts" or "quite knowledgeable," versus only 61 percent of the non-stars. This further evidence of stars having stronger programming inclinations reflects my earlier supposition based on the bulletin boards which have dominant star participation. The overall high percentage of skilled programmers in both categories is not surprising; recall that over 62 percent of the bulletin boards address programming topics.

### Table 5-6: Programmer Skill Classifications

<table>
<thead>
<tr>
<th>Skill Level</th>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert</td>
<td>28</td>
<td>20</td>
</tr>
<tr>
<td>Quite Knowledgeable</td>
<td>34</td>
<td>23</td>
</tr>
<tr>
<td>Average</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>Inexperienced</td>
<td>5</td>
<td>8</td>
</tr>
<tr>
<td>Novice</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>75</td>
<td>70</td>
</tr>
</tbody>
</table>

Programming seems to be a job responsibility for most respondents, stars and non-stars alike; 79 percent of the stars and 68 percent of the non-stars indicate that they program a computer as part of their job. Further, 47 percent of the stars and 42 percent of the non-stars indicate that their area of programming is related to the subject of the electronic bulletin board system. Familiarity with the use and subject of the bulletin board system is probably of
assistance to this group in particular. No significant difference exists between stars and non-stars in this area.

**Experience with the Electronic Bulletin Board System**

One part of the survey addresses experience with the electronic bulletin board system. Respondents were asked how long they had used the bulletin board system. Over half the stars and half the non-stars have used the system for over two years, the maximum time asked. No significant difference exists between stars and non-stars in this area.

However, stars and non-stars differ in their knowledge of the electronic bulletin board system as would be expected by their differing levels of participation. Table 5-7 shows the distribution of responses to the question on the level of knowledge of the system, with stars considering themselves more expert (chi-squared test, p < .005). Table 5-8 shows the replies to a similar question concerning the expertise of the respondents on a particular bulletin board subject relative to the "average" contributor to that bulletin board. Again, stars consider themselves more knowledgeable than non-stars (p < .005). The greater confidence stars show in their knowledge is reflected in their more frequent participation, although no causal relationship is claimed.

**Table 5-7: Distribution on Bulletin Board Knowledge**

<table>
<thead>
<tr>
<th>BB Knowledge Level</th>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expert</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Quite Knowledgeable</td>
<td>46</td>
<td>27</td>
</tr>
<tr>
<td>About Average</td>
<td>15</td>
<td>35</td>
</tr>
<tr>
<td>Not Very Much</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>75</td>
<td>70</td>
</tr>
</tbody>
</table>
Table 5-8: Distribution of Relative Subject Knowledge

<table>
<thead>
<tr>
<th>Relative Knowledge</th>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Much Greater</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Somewhat Greater</td>
<td>33</td>
<td>20</td>
</tr>
<tr>
<td>About the Same</td>
<td>29</td>
<td>23</td>
</tr>
<tr>
<td>Somewhat Less</td>
<td>5</td>
<td>16</td>
</tr>
<tr>
<td>Much Less</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>74</td>
<td>68</td>
</tr>
</tbody>
</table>

Bulletin Board Job Responsibilities

Stars may be more frequent participants simply because it is part of their job responsibilities. Several questions in the survey addressed this point directly. Over 30 percent of the stars indicate that following or using the bulletin board system is part of their job, while only slightly more than seven (7) percent of the non-stars so respond, a significant difference between the groups (chi-squared test, $p < .005$).

Further, 22 percent of the stars indicate that providing assistance to others in the subject areas addressed by the bulletin board system is part of their formal assignment, while only 5.6 percent of the non-stars so indicate, another significant difference ($p < .025$). An additional 55 percent of the stars and 62 percent of the non-stars indicate that assisting others was something they do even though it is not a part of their job.

Active bulletin board participation and related job assignments seem to lead to another difference in stars and non-stars. Almost 58 percent of the stars can access the electronic bulletin board system after hours from their homes, while less than 37 percent of the non-stars have this capability, a significant difference ($p < .01$). Company practices generally support access from home with employee
provided equipment, although the company will provide all equipment if particular business needs are being served. Home access allows broader reading of bulletin board subjects of personal interest to participants without distracting from current job assignments, a definite plus. Such access would surely lead to higher participation rates.

**Bulletin Board System Serving as Contact Initiator**

An electronic bulletin board message is addressed to a broad, unknown audience. With all messages tagged with user identification, bulletin board participants may establish new, valuable contacts, usually outside their own organizations. The bulletin board system may introduce participants to others of compatible interests. The literature reports other systems being used to establish sports partners and the like, but such messages are not allowed on this system.

To explore the degree to which new contacts are established, participants were asked two sets of questions. First, they were asked to indicate the percentage of bulletin board contacts known prior to using the bulletin board system. That is, did the participant know the person prior to a bulletin board message exchange. Ninety-two (92) percent of the stars and 97 percent of the non-stars reported knowing "almost none (less than 10 percent)" prior to communicating with them through the bulletin board system.

Next, the respondents were asked to indicate with how many people they now regularly (monthly) communicate who were "met" through the bulletin board system. The statistics for the answers for both stars and non-stars are shown in Table 5-9. While neither stars nor non-stars report many direct personal contacts, the stars do have significantly more such contacts ($p < .01$). No significant difference exists between stars and non-stars for phone contacts, with each group averaging a single new contact. However, stars retain
significantly more new electronic mail contacts (7.5 new regular monthly contacts) than non-stars (p < .005). One would suspect that these new acquaintances are quality contacts since the cessation of relations would be so easy.

Table 5-9: New Regular Contacts Met Via Bulletin Board

<table>
<thead>
<tr>
<th>Contact Method</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stars:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Personal</td>
<td>0.67</td>
<td>1.13</td>
</tr>
<tr>
<td>Telephone</td>
<td>1.03</td>
<td>1.87</td>
</tr>
<tr>
<td>Electronic Mail</td>
<td>7.51</td>
<td>13.84</td>
</tr>
<tr>
<td><strong>Non-Stars:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Direct Personal</td>
<td>0.24</td>
<td>0.64</td>
</tr>
<tr>
<td>Telephone</td>
<td>0.83</td>
<td>3.08</td>
</tr>
<tr>
<td>Electronic Mail</td>
<td>2.63</td>
<td>5.26</td>
</tr>
</tbody>
</table>

These are not the only ways to remain in touch with new bulletin board colleagues. In interviews with the department responsible for the bulletin board system, one person indicated that he and several physically remote colleagues have cloned a small bulletin board system for communication among themselves without access by others. It is possible that other small communities have also been created as users with like interests find each other through the larger bulletin board system.

5.4 PARTICIPANT ACTIVITY LEVELS

The first part of the survey explores the level of activity of each participant. Each was asked the number of bulletin boards regularly read during a month, and the frequency with which the bulletin board system is read. Then each participant was asked the same two questions concerning regular contributions to bulletin boards.
Since the survey was distributed in late January and January activity levels were about the same as the October levels, I can assess the accuracy of the contribution estimates by drawing on my October data base. Table 5-10 presents the participation statistics for stars and non-stars, including the actual October contribution statistics.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Stars:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BB's Read</td>
<td>54.05</td>
<td>98.42</td>
</tr>
<tr>
<td>Est. Contributions</td>
<td>10.57</td>
<td>23.52</td>
</tr>
<tr>
<td>Oct. Contributions</td>
<td>11.09</td>
<td>9.50</td>
</tr>
<tr>
<td><strong>Non-Stars:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>BB's Read</td>
<td>48.44</td>
<td>106.52</td>
</tr>
<tr>
<td>Est. Contributions</td>
<td>2.51</td>
<td>2.94</td>
</tr>
<tr>
<td>Oct. Contributions</td>
<td>2.40</td>
<td>3.41</td>
</tr>
</tbody>
</table>

The participants are remarkably accurate in their estimates of the number of unique bulletin boards to which they contribute; no significant difference exists in their estimates of number of bulletin boards and the actual October count of unique bulletin boards to which they contributed. Hence, I confidently assume that the estimated number of bulletin boards read regularly is also accurate.

Both stars and non-stars regularly read fifty (50) bulletin boards, about a tenth of the entire information data base of five hundred bulletin boards; even the variance in number of bulletin boards read is approximately the same. No statistical difference exists between stars and non-stars on this measure of activity. Both stars and non-stars seem to be equally well informed and hungry for information.
Do stars and non-stars differ in the frequency with which they read bulletin boards? Table 5-11 presents the answers to the frequency question of the survey, "How often do you read bulletin boards?" The respondents were presented a list of choices, and the number of respondents in each category is shown.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once/Day</td>
<td>74</td>
<td>48</td>
</tr>
<tr>
<td>Several/Week</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>Once/Week</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>Several/Month</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Once/Month</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Less Than Once/Month</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Both stars and non-stars seem to access the bulletin board system daily to scan for new information in bulletin boards of interest. Accessing and reading the bulletin boards is a part of their daily work routine. No star would consider accessing as infrequently as once a week; this is understandable considering the volume of information which would accumulate in fifty bulletin boards in a week (about five hundred messages on average). Similarly, non-stars access frequently to "keep up", although there appear to be some non-stars who access the system less frequently; these non-stars are probably only superficially skimming information or scanning for specific key terms of interest.

To test for a significant difference between stars and non-stars, I divided the responses into two groups, daily and less than daily, and performed a chi-squared test. The test showed that stars access more frequently than non-stars, and the difference is significant (p < .005).
5.5 METHODS OF ASKING AND ANSWERING QUESTIONS

To probe the methods in which the electronic bulletin board system is used, a series of items in the survey focused on the ways in which bulletin board questions received replies. Three areas are probed: First, the methods used to reply to a prior bulletin board question of the survey respondent; second, the method the survey respondent herself uses to respond to a bulletin board question; and finally, an estimate of the amount of non-question/answer material the survey respondent injects into the bulletin board.

Many Replies Received to Bulletin Board Question

First, each participant was asked to recall the last question she had placed in a bulletin board. She was asked the number of replies received, the different ways she received those replies (bulletin board answer, direct electronic mail response not through a bulletin board, telephone call, or visit in person), the way she received the first reply, and the way she received the best reply.

Table 5-12 shows the number of replies received for both stars and non-stars; no significant difference exists. Each group receives on average four to five replies, although a wider variance exists for non-stars. This large number of replies to a bulletin board question indicates a very responsive problem resolution tool, although it does not indicate effectiveness per se.

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stars</td>
<td>4.03</td>
<td>3.01</td>
</tr>
<tr>
<td>Non-Stars</td>
<td>5.05</td>
<td>12.74</td>
</tr>
</tbody>
</table>

85
Bulletin Board Replies Are Mostly Electronic

Table 5-13 shows the distribution of replies to bulletin board questions. The reply patterns for both stars and non-stars are not statistically different: Nearly all the replies are received by electronic means, with almost all questions receiving both a bulletin board reply and a direct electronic mail reply which does not pass through a bulletin board. Relatively few replies are received by a direct synchronous communication - telephone or personal visit. The convenience and asynchronous nature of the electronic exchange seems to favor those techniques. The electronic means also retains some degree of social distance - a casual phone reply can turn into a long heated debate.

Table 5-13: Methods of Reply to BB Questions

<table>
<thead>
<tr>
<th>Method</th>
<th>Star</th>
<th>Non-Star</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulletin Board</td>
<td>69</td>
<td>51</td>
</tr>
<tr>
<td>Electronic Mail</td>
<td>63</td>
<td>54</td>
</tr>
<tr>
<td>Telephone Call</td>
<td>16</td>
<td>13</td>
</tr>
<tr>
<td>Personal Visit</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Total Survey Answers</td>
<td>74</td>
<td>60</td>
</tr>
</tbody>
</table>

The low number of telephone replies and personal visit replies hints at the effectiveness of the bulletin board system in resolving problems. Without an extensive network into which to inject questions, only the two direct channels of problem resolution would exist. I cannot claim conclusively that those channels would be inadequate for the task, for certainly stronger support systems would spring up in absence of the bulletin board system to resolve problems.

For almost all the questions, the first reply arrives by electronic means. For only two stars and two non-stars responding to the survey did the first reply to their bulletin
board inquiries arrive by phone. Similarly, the best reply arrives by electronic means. Again, only two stars and two non-stars rate the telephone replies to their bulletin board questions "best." In no case is a personal visit rated either "first" or "best."

Table 5-14 presents the various combinations of electronic replies being "first" and "best" for both stars and non-stars, for only those respondents who indicated receiving both types of replies. Bulletin board replies and direct electronic mail replies appear to be equally rapid and seem to be of comparable quality according to the rather symmetric split of answers. Further, no significant difference exists in the pattern for stars and non-stars.

**Table 5-14: Breakdown of Multiple Reply Counts**

<table>
<thead>
<tr>
<th></th>
<th>First</th>
<th>Best</th>
<th>Star</th>
<th>Non-Star</th>
</tr>
</thead>
<tbody>
<tr>
<td>BB</td>
<td>BB</td>
<td>20</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>BB</td>
<td>E-Mail</td>
<td>7</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>E-Mail</td>
<td>BB</td>
<td>9</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>E-Mail</td>
<td>E-Mail</td>
<td>21</td>
<td>14</td>
<td></td>
</tr>
</tbody>
</table>

Respondents Pleased with Quality of Replies

The degree of satisfaction of the participants is reflected in their reply to the survey question, "Was the best answer (received to your bulletin board question) satisfactory?" Table 5-15 summarizes the response which was overwhelmingly positive with 92.3 percent responding "yes." There is no significant difference between the response for stars and non-stars. This result, combined with the large number of responses received to a bulletin board question, is a strong indication of the power of this medium in resolving problems.
Table 5-15: Satisfaction with Answer to BB Question

<table>
<thead>
<tr>
<th></th>
<th>Stars</th>
<th>Non-Stars</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfactory</td>
<td>69</td>
<td>51</td>
<td>120</td>
</tr>
<tr>
<td>Not Satisfactory</td>
<td>4</td>
<td>8</td>
<td>12</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>73</td>
<td>59</td>
<td>130</td>
</tr>
</tbody>
</table>

Respondents Usually Send Bulletin Board Answers

The next questions in the survey probes the favored way for a participant to answer a bulletin board question. With most participants reading the bulletin boards daily, the opportunity to provide timely answers exists for the participants. In the survey, each participant was asked to recall the last bulletin board question she answered, and mark among four choices the way in which it was answered -- by a bulletin board answer, a direct electronic mail reply not through the bulletin board, a telephone call, or a personal visit. The results are shown in Table 5-16 for both stars and non-stars, who do not differ significantly in their replies.

Table 5-16: Methods of Answering BB Question

<table>
<thead>
<tr>
<th>Method</th>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulletin Board</td>
<td>63</td>
<td>39</td>
</tr>
<tr>
<td>Electronic Mail</td>
<td>12</td>
<td>16</td>
</tr>
<tr>
<td>Telephone Call</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Personal Visit</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

The high percentage of bulletin board answers contradicts the apparent trend above of equal numbers of bulletin board replies and direct electronic mail replies being received to questions placed in the bulletin board system. This seeming contradiction is best explained by considering that all the respondents are participants in the bulletin board system. As
a group, they are familiar with the method of appending messages to existing bulletin boards and have overcome any initial reluctance to register answers in such a public way.

The large population of bulletin board readers who do not participate (estimated to be several times larger than contributors) apparently are sending direct electronic mail replies, a task very familiar to all computer system users.

Over One Third of Contributions are Dicta

Finally, the proportion of traffic the survey participant appends to bulletin boards which are dicta (that is, neither questions nor answers) was solicited. Table 5-17 presents the result for both stars and non-stars. No significant difference exists between the estimates for the two groups. However, the message sampling in the previous chapter would have led me to believe that stars would have had a slightly higher percentage of dicta. Part of the discrepancy can be attributed to the lack of a detailed description of what to consider dicta in the survey. Nevertheless, much of the traffic that the respondents indicate they generate is not directly to ask or answer a question, but rather to participate in a group discussion or to add to the bulletin board's cumulative information.

Table 5-17: Percent Non-Question/Answer Contributions

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stars</td>
<td>35.99%</td>
<td>24.69%</td>
</tr>
<tr>
<td>Non-Stars</td>
<td>39.02%</td>
<td>29.12%</td>
</tr>
</tbody>
</table>

Summary of Response Methods

Basically, stars and non-stars use the bulletin board system similarly. Each group receives at least several
replies to the average question, and these replies are received electronically either through an addition to the bulletin board or through a direct electronic mail reply. More direct personal contact by phone or in person is the exception. Both stars and non-stars are overwhelmingly pleased with the quality of the replies.

Both groups prefer to respond to bulletin board questions with a bulletin board reply as opposed to direct electronic mail. There seems to be another class of bulletin board users who read bulletin boards and send direct electronic answers. This group escapes detection in my method of only recording contributors for my survey data base.

Finally, both groups are willing to participate in group discussions or inject general hints without having a particular problem to solve, whether it be their own problem or the problem of another user.

5.6 PROBLEM RESOLUTION PROCEDURES

The electronic bulletin boards offer a relatively low social cost mechanism for problem resolution. Simply searching relevant bulletin boards for mention of a particular problem can even be easier than trying to find the information in paper manuals or by trial and error if terminals are readily available.

A higher social cost exists for placing a query in a bulletin board. Your name is on the query for a world wide user community to see; and it could be a "stupid" question. On the other hand, a user appending a query to the bulletin board does not personally know this world wide community, and is unlikely to be remembered if he happens to meet them in the future. Contrast this to the social cost incurred when asking a local "expert" a question.
I suspect that users will tend to invoke the lower social cost media first in hopes of solution. Hence, I hypothesized above that scanning electronic bulletin boards for information would rank high among the order of invoking resolution mechanisms.

Computing a Ranking for Order and Effectiveness

Data from the survey on the order and effectiveness of invoking problem resolution mechanisms is analyzed as follows. Only the top three choices of each respondent are coded. The top response is awarded three points; the next, two points; and the third, one point. If fewer than three categories are ranked, points are assigned to only those ranked, with three points to the highest. The rationale for ignoring fourth and fifth ranked items is two-fold: First, almost all respondents rank at least three, but barely a majority more than three; thus, adding points for the fourth and fifth choices gives those respondents more influence in the results. Second, the fourth and fifth ranked mechanisms are relatively unimportant in my judgment and would rarely be reached in most problem resolution procedures. Thus a weight of zero points is not inappropriate. The results are summarized in Table 5-18, with the individual point scores of each item in parentheses. An alternative scoring system is used later in this section, with much the same result.
**Table 5-18:** Order and Effectiveness Rank (3 Pt Scale)

<table>
<thead>
<tr>
<th>Order</th>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Read BB</td>
<td>Read BB</td>
</tr>
<tr>
<td>Manuals, Trials</td>
<td>(123)</td>
<td>(103)</td>
</tr>
<tr>
<td>Query in BB</td>
<td>(81)</td>
<td>Consult Peer</td>
</tr>
<tr>
<td>Consult Peer</td>
<td>(42)</td>
<td>Consult Expert</td>
</tr>
<tr>
<td>Consult Expert</td>
<td>(39)</td>
<td>Query in BB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effectiveness</th>
<th>Read BB</th>
<th>Manuals, Trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>Query in BB</td>
<td>(142)</td>
<td>(75)</td>
</tr>
<tr>
<td>Read BB</td>
<td>(125)</td>
<td>Consult Expert</td>
</tr>
<tr>
<td>Manuals, Trials</td>
<td>Consult Peer</td>
<td>Consult Peer</td>
</tr>
<tr>
<td>Consult Expert</td>
<td>(46)</td>
<td>(44)</td>
</tr>
</tbody>
</table>

**Low Social Cost Mechanisms Used First**

My suspicions concerning the influence of social cost are confirmed. Both stars and non-stars invoke the lowest social cost mechanisms first to resolve a problem: First, they search for the problem in the relevant electronic bulletin boards, then attempt to resolve the problem by reading the manuals and by trial and error.

There is a difference between stars and non-stars in the order of invocation of the next set of problem resolution techniques. After searching bulletin boards and manuals, stars invoke the broad user community of bulletin board watchers for an answer to their problem. Non-stars seek human help (peers before experts) before invoking the bulletin board community, although there is only a small difference in rating the order of consulting the local expert versus the bulletin board experts.

Several explanations can be advanced for this minor difference. (The difference is not statistically significant}
by a chi squared test.) Stars may simply be more confident that their question is not "stupid," and hence willing to invoke the effective bulletin board query vehicle more quickly. Since they are more frequent contributors, there is no technology or training barriers to using that mechanism. And, they have paid their "dues" by contributing answers to others' questions in the past.

On the other hand, stars may not have local people with whom to consult. They may be the "local expert" and have no one with more expertise to consult, and may not even have anyone of similar expertise (a peer) to consult. Indeed, their only method of finding users of similar or superior background could be the electronic bulletin board system. This conjecture is supported partly by numerous write-in comments on the survey forms, beside the entry "consult the local 'expert,'" that the respondent was the expert.

The lack of people with whom to consult seems to influence the order ranking for stars. An alternative ranking is presented below which may better represent the order of consultation assuming that all channels exist.

**Bulletin Boards Provide the Most Effective Channels**

In terms of effectiveness, stars and non-stars largely agree. (Again, the difference is not statistically significant by a chi-squared test.) The electronic bulletin boards serve as the most effective vehicle to resolve problems. Use of product manuals and trial and error comes in a distant third, followed by a poor showing for local human resources (with expert over peer).

The difference between the two groups on the effectiveness rank which is given to reading and placing a query in a bulletin board could have several explanations. The stars may be more attuned to the proper questions for
bulletin boards. Recall that in the sampling of messages, many questions did not receive an answer in the bulletin boards, especially non-technical questions. Stars may know better than to ask such questions, while non-stars may not be as sensitive.

Stars may have more difficult questions to resolve than non-stars, or as perhaps initial users of a particular system or tool, stars may first encounter the initial problems. Later, non-stars may reach the same problems which others have encountered and documented in the bulletin boards. Regardless, both groups definitely consider the bulletin boards to be the superior source of information.

An Alternative Ranking Method

Since the lack of experts or peers may influence rankings in the coding scheme I employed, I now consider a different ranking scheme which allows a ranking assuming that all channels are available. To compute this ranking, each questionnaire is re-examined. If a respondent ranked more than one item, the relationship between each pair of responses is examined. The highest ranked item is considered to have "beaten" all others, the next highest to have "beaten" all but the first, and so on. For example, if the respondent ranked "experts" as "1", "query BB" as "2", and "peers" as "3", then "experts" would have been scored a point against "query BB" and against "peers", and "query BB" would have scored a point against "peers."

After all responses were processed, a winning percentage for each item against each other item is computed. If "experts" have 15 points against "peers" and "peers" had 10 points against "experts", then "experts" had a 60% (15/25) score against "peers". Then the matrix of all the scores for all possible combinations is examined. The alternative which "beat" all others by having at least a 50% winning percentage
against each of them is considered the first choice. Second choice fell to the alternative that beat all but the first, and so on.

This coding scheme allows those persons using problem resolution channels to score their preferences for channels they use without penalizing alternative channels which are not available to them. Hence, a ranking can be made of the alternatives as if they all are available. This alternative ranking is presented in Table 5-19.

**Table 5-19: Order and Effectiveness Rank (Pair System)**

<table>
<thead>
<tr>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manuals, Trials</td>
<td>Manuals, Trials</td>
</tr>
<tr>
<td>Read BB</td>
<td>Read BB</td>
</tr>
<tr>
<td>Consult Expert</td>
<td>Consult Expert</td>
</tr>
<tr>
<td>Consult Peer</td>
<td>Consult Peer</td>
</tr>
<tr>
<td>Query in BB</td>
<td>Query in BB</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Consult Expert</td>
</tr>
<tr>
<td>Manuals, Trials (Tie)</td>
</tr>
<tr>
<td>Consult Peer (Tie)</td>
</tr>
</tbody>
</table>

The results of this alternative ranking are largely unchanged. The low social cost vehicles still rank as the first two mechanisms invoked, although their order is reversed. "Consulting experts" improves its position in both order and effectiveness, reinforcing my supposition that the other ordering may have been biased against many respondents who do not have access to experts. But the experts still come in third behind both styles of accessing electronic bulletin boards for problem resolution.
5.7 MOTIVATIONS FOR PARTICIPATION

From the above discussions, the participants clearly feel that the electronic bulletin board system is a superior method to resolve problems. I now turn to examine further the motivation for participating.

A major section of the survey dealt with the importance the participant associated with eleven different potential motivations for participation. The participant was asked to rank the importance of the factors on a seven point scale, and to rank each according to (1) the importance relative to his current job, and (2) the importance relative to his personal desires.

The distinction between job and personal desires deserves further discussion. I feel that the electronic bulletin board system is relatively new and has not been incorporated into the job descriptions of many employees, despite its obvious value to them as shown above. However, I believe it has enabled many people to perform better on their jobs. Thus to increase the variation in job and personal ratings, I explicitly requested that the job importance be relative to how each participant's manager would view the task.

The answers are segregated by star and non-star coding of the survey. The raw scores are presented in Figure 5-1, with a brief explanation of the question and the statistical significance between job and personal rankings for both stars and non-stars in Table 5-20. Significance between job and personal importance rankings is determined by a t-test between the scores.
Figure 5-1: Raw Importance Scores (7 Point Scale)
Table 5-20: Significance - Job and Personal Importance

<table>
<thead>
<tr>
<th>Stars</th>
<th>Non-Stars</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Keep up with BB Topics</td>
<td>p &lt; .0005</td>
</tr>
<tr>
<td>b. Solve a Technical Problem</td>
<td>p &lt; .0005</td>
</tr>
<tr>
<td>c. Solve a Non-tech Problem</td>
<td>p &lt; .0005</td>
</tr>
<tr>
<td>d. Satisfy Curiosity</td>
<td>p &lt; .0005</td>
</tr>
<tr>
<td>e. Seek Product Reviews</td>
<td>p &lt; .0005</td>
</tr>
<tr>
<td>f. Help Other Users</td>
<td>p &lt; .0005</td>
</tr>
<tr>
<td>g. Get Help from Other Users</td>
<td>p &lt; .0005</td>
</tr>
<tr>
<td>h. Reach Specific People</td>
<td>p &lt; .025</td>
</tr>
<tr>
<td>i. Tap Group Knowledge</td>
<td>p &lt; .005</td>
</tr>
<tr>
<td>j. Generate New Ideas</td>
<td>p &lt; .0005</td>
</tr>
<tr>
<td>k. Maintain a Bulletin Board</td>
<td>p &lt; .0005</td>
</tr>
</tbody>
</table>

I first examine the relative importance of the major motivations for both stars and non-stars, and then examine the difference between the degree of motivation for personal and job reasons. Then I will probe for significant differences between stars and non-stars.

Relative Importance of Major Motivations

The first data discussed from Figure 5-1 relates to the relative importance of the motivations. As anticipated from the above discussion on problem resolution, "solving technical problems" (b) and "getting help from others" (g) rank very high for both stars and non-stars. Also, both stars and non-stars rank "keeping up" (a) and "curiosity" (d) highly. Relative to other questions, these four are most important for both job and personal reasons.

For stars, two other motivations also rank high: "Helping others" (f) is deemed as important as the above motivations, as is "maintaining bulletin boards" (k); these
are discussed later when the differences between stars and non-stars are explored.

Both stars and non-stars rank "solving non-technical problems" (c) low. This supports my finding in the previous chapter on sampling, where a high percentage of unanswered non-technical questions was found. I have a stronger result now: It seems that such questions not only go unanswered in the bulletin board, but that direct answers (by phone or direct electronic mail) are not received either. This electronic bulletin board system does not serve to resolve non-technical questions.

Both groups also rank "reaching specific people" (h) very low. For some electronic bulletin board systems, this seems to be important motivation, especially some commercial systems spanning several companies. But with this particular system, sending direct electronic mail is easier and quicker than appending a message to a bulletin board. Thus, this is not a surprising result.

The other motivations receive intermediate ratings. Concept discussions and group problem solving reflected by "generate new ideas" (j) and "tap group knowledge" (i) received intermediate scores. This tends to show less enthusiastic feelings toward the many Concept bulletin boards than the product-oriented bulletin boards.

"Seek product reviews" (e) received an intermediate score. This category reflects the ability to explore alternative tools (say graphics) for the relative strengths and weaknesses before acquiring them for a participant's own use.

**Personal Motivations Exceed Job Motivations Significantly**

In comparing the relative importance of job and personal motivations for each group (stars and non-stars), both Figure
Table 5-1 and Table 5-19 show the dominance of personal motivation driving participation. Only in one instance, non-star ratings for "contacting specific people" (h) is there no statistical significance.

This overwhelming difference in importance ratings clearly indicates that personal motivations drive bulletin board participation. However, the degree of difference may indicate that the organization does not recognize the effectiveness of the bulletin boards for problem resolution as indicated in the ratings of effectiveness. As the organization becomes more aware of the power of the electronic bulletin board system, the difference should diminish.

An alternative explanation exists for the large difference between personal and job ratings, although it appears less likely. The importance scales relating to the job were restricted to the participant's opinion of what her manager would agree was important. The management team may be more enlightened than anticipated by the participant. Indeed, the number of persons with access to the bulletin board system from home indicates at least a broad tolerance to participation and recognition of at least indirect benefits to the organization and individual morale.

**Star versus Non-Star Importance Ratings**

So far, stars and non-stars largely agree on the relative importance of the motivations for both job and personal reasons. Both stars and non-stars show significantly stronger motivation to participate due to personal drive rather than job requirements. Now I examine the areas where stars differ from non-stars and attempt to draw conclusions on any variation in motivation.

The difference between the personal motivations for stars and non-stars, and the difference between the job motivations
for stars and non-stars are shown in Table 5-21. Significance between star and non-star importance rankings was determined by a t-test between the scores.

**Table 5-21: Significance - Star and Non-Star Importance**

<table>
<thead>
<tr>
<th></th>
<th>Personal</th>
<th>Job</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Keep up with BB Topics</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>b. Solve a Technical Problem</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>c. Solve a Non-tech Problem</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>d. Satisfy Curiosity</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>e. Seek Product Reviews</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>f. Help Other Users</td>
<td>p &lt; .005</td>
<td>p &lt; .025</td>
</tr>
<tr>
<td>g. Get Help from Other Users</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>h. Reach Specific People</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>i. Tap Group Knowledge</td>
<td>n.s.</td>
<td>n.s.</td>
</tr>
<tr>
<td>j. Generate New Ideas</td>
<td>p &lt; .025</td>
<td>n.s.</td>
</tr>
<tr>
<td>k. Maintain a Bulletin Board</td>
<td>p &lt; .005</td>
<td>p &lt; .01</td>
</tr>
</tbody>
</table>

Compared with the significance between job and personal motivations in Table 5-20, there are relatively few significant differences between stars and non-stars. For those difference which do exist, stars rate the motivations more significant than non-stars.

The most outstanding difference reinforces my earlier hypothesis that stars act as information providers in the electronic bulletin board system. Stars are significantly more motivated to "help other users" (f), both as part of their job motivations and part of their personal motivations.

Another significant difference follows naturally from the higher participation level of stars in the bulletin board system. Stars are significantly more likely to be motivated to "maintain a bulletin board" (k) in the electronic bulletin board system than non-stars. This is reflected both in the
job motivations and the personal motivations. The higher interest level of stars, reflected by their higher participation rates, correlates with the ownership of one of the five hundred active bulletin boards. The direction of this relationship is undetermined: Bulletin board owners may naturally contribute many messages to their own bulletin board and hence obtain the "star" rating; on the other hand, their overall interest in the bulletin board make them more likely to volunteer to edit active bulletin boards as the owner.

The final significant difference is that stars have greater personal motivation to "generate new ideas" (j), probably through Concept bulletin boards. These active users may be considering broad new applications of technology to a variety of problems.

5.8 SUCCESSFUL USE OF THE BULLETIN BOARD SYSTEM

The above analysis has yielded information on the basic motivations of the participants, both on the basis of the participant being a star or a non-star in activity level, and on the basis of the motivation being personal or job-related.

I now move to examine how successfully the electronic bulletin board system has met those motivations. In the survey, participants were asked to rate on a seven-point scale the success of bulletin board use in meeting certain objectives. Figure 5-2 presents the average success ratings for both stars and non-stars. Table 5-22 briefly summarizes the satisfaction motivations and indicates on which ratings stars differed significantly from non-stars.
Figure 5-2: Satisfaction Ratings for Stars and Non-Stars

Table 5-22: Satisfaction Difference - Stars

<table>
<thead>
<tr>
<th>Question</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Receiving Answers to Questions</td>
<td>n.s.</td>
</tr>
<tr>
<td>b. Finding Product Reviews</td>
<td>n.s.</td>
</tr>
<tr>
<td>c. Solving BB Users Problems</td>
<td>n.s.</td>
</tr>
<tr>
<td>d. Solving Department Problems</td>
<td>n.s.</td>
</tr>
<tr>
<td>e. Gaining Feedback on Ideas</td>
<td>p &lt; .05</td>
</tr>
<tr>
<td>f. Gaining Feedback on Products</td>
<td>n.s.</td>
</tr>
</tbody>
</table>

From Figure 5-2, both stars and non-stars are very satisfied with the electronic bulletin board system on each success factor, with the average scores being between five and six (best is seven). There is only a single significant difference: Stars are more satisfied with using the bulletin
boards to "gain feedback on new ideas" (e) than non-stars. This reinforces the earlier result of the higher importance stars accord to idea generation in bulletin boards noted above.

Both stars and non-stars are satisfied with the bulletin board system for resolving problems for users in their departments (d) and for other bulletin board users (c) with whom they have no direct job relationship.

The overall high degree of satisfaction of the participants is also reflected in their reply to the survey question, "Was the best answer (received to your bulletin board question) satisfactory?" Table 5-15 above summarizes the response which was overwhelmingly positive with 92.3 percent responding "yes". There is no significant difference between the response for stars and non-stars.

5.9 SURVEY RESULTS SUMMARY

Again, a quick summary of the results of this chapter is appropriate before addressing the final analysis of the survey in the next chapter.

1. **Stars and non-stars did not differ in job performance.** No significant difference exists in either performance ratings or promotion timing. (Does not contradict hypothesis 5-9.)

2. **Stars consider themselves to be more skilled programmers than do non-stars.** (Supports hypothesis 5-1.)

3. **Stars have more knowledge of the bulletin board system than do non-stars, and stars have job assignments requiring the tracking of bulletin boards more often than non-stars.** (Supports hypothesis 5-7).
4. Both stars and non-stars know almost none of their bulletin board contacts prior to use of the bulletin board system. (Supports hypothesis 5-8.)

5. Stars establish more new regular contacts through the bulletin board system than do non-stars. The bulletin board system serves to forge new communication links in the organization.

6. Stars and non-stars accurately predicted their participation levels. The lack of social cues does not seem to result in a higher degree of self-centered behavior reflected by overstating their activity. (Does not support hypothesis 5-2).

7. Stars and non-stars regularly read about the same number of bulletin boards (fifty), although stars read them a bit more often in general.

8. Both stars and non-stars receive multiple replies on average to their bulletin board questions, and most replies are electronic (bulletin board replies or direct electronic mail answers). There is no difference in the speed or quality of the electronic answers. An overwhelming percentage (92.3) of respondents are satisfied with the best answer. (Supports hypothesis 5-3.)

9. Both stars and non-stars send bulletin board answers to bulletin board questions; non-participants seem to send a significant number of direct electronic mail answers to the same questions. This supposition is based on the nearly equal number of bulletin board answers and direct electronic mail answers received by respondents, but the indication that participants respond with a bulletin board answer most often (reflecting a system more to create permanent information to reference.)

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10. Reading bulletin boards is the favored first problem resolution scheme invoked by both stars and non-stars, probably due to its low social cost. (Supports hypothesis 5-10.)

11. Reading or placing questions in the bulletin boards is the most effective problem resolution technique for the participants. (Supports hypothesis 5-11.)

12. Both stars and non-stars exhibit much stronger personal motivations for participation than job-related motivations.

13. Stars and non-stars exhibit equally strong desires to "keep up" or "satisfy curiosity" as a motivation for using the bulletin board system. (Does not support hypothesis 5-5.)

14. Stars exhibit stronger desires to help others as a motivation for participation than do non-stars. However, this desire is still a strong motivation for non-stars as well. (Supports hypothesis 5-6.)

15. Stars and non-stars did not differ on any important measure in their satisfaction with the success of using the bulletin board system. (Does not support hypothesis 5-4).
CHAPTER 6: CONTRIBUTOR TRENDS

6.1 SURVEY SELECTION

The previous chapter focused on the specific responses to the survey and probed for particular differences between stars (frequent contributors) and non-stars. In this chapter, other potential correlations in the survey are examined. Note that the survey was only distributed to domestic participants.

The same survey data are used for this chapter with a particular selection of responses. There are 71 responses from 1671 domestic non-stars in the survey, or 4.25 percent. Therefore, the same percent of replies from domestic stars are extracted to supplement the non-star participant replies to form a more uniform distribution of replies for this chapter; in this case, 4.25 percent of domestic stars is five respondents. The five surveys were chosen by selecting five random numbers between one and 77 (the number of star replies), and adding these particular replies from the data base to the non-star responses to form a new set of surveys for analysis.

6.2 CORRELATIONS EXAMINED

Each survey yielded over eighty individual answers; this chapter does not examine each possible correlation. Rather, using intuition and insight from the previous analyses on possible relationships, the field is narrowed considerably. Table 6-1 summarizes the key questions selected for examination (the question number is in parentheses), and Table 6-2 grossly indicates the correlations between areas which were examined.
In general, rather few specific correlations were found. The ones found, and several of those expected but not proven, are discussed below.

Table 6-1: Questions Used in Correlation Examination

DEMOGRAPHICS:
Years of Service (VI1)
Job Level (VI4)
Performance Rating (VI6)
Years of Computer Usage (V1)
Programming Skills (V3)
Programming Job (V4)
Helping Part of Job (V5)
Knowledge of BB System (IV2)
Relative Topic Knowledge (IV3)

ACTIVITY LEVELS:
Number of BB Read (I4)
Number of BB Contributed (I7)
Percentage Dicta (II11)

MOTIVATIONS AND SUCCESS:
Problem Solving (III2b,c,g)
Keeping Up (III2a,d)
Helping Others (III2f)
Success with Problems (III3a)

Table 6-2: Areas Examined for Correlation

<table>
<thead>
<tr>
<th>Activity</th>
<th>Motivation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographics</td>
<td>Yes</td>
</tr>
<tr>
<td>Activity</td>
<td>No</td>
</tr>
<tr>
<td>Motivation</td>
<td>Yes</td>
</tr>
</tbody>
</table>
6.3 CORRELATION OF DEMOGRAPHICS AND ACTIVITY LEVELS

Recall from the previous chapter that the estimated number of unique bulletin boards to which respondents contributed closely matched the average for their group (stars and non-stars). For the following analysis, I assume that their estimates for contributions are sound. Further, I assume their estimates for the number of unique bulletin boards read and the percentage of contributions which are dicta are accurate. These three measures, bulletin boards read, bulletin boards contributed, and dicta percentage, serve as my measure of activity levels.

The demographic questions are largely multiple choice. For each possible choice, statistics on the activity levels are calculated to allow an analysis of variance (ANOVA) to be performed.

No Difference in Basic Demographics

Respondents with between sixteen and twenty years of service with the company (question VII) on average contribute to over twenty unique bulletin boards each, compared to the average contribution level of slightly over five unique bulletin boards. However, there is a large variance in this level of contribution, and the ANOVA test does not confirm a significant difference between the various service levels.

Consistent with this, the respondents in the highest job levels (question VI4) contribute to over seventeen unique bulletin boards each. But again, there is a large variance, and the ANOVA test fails to confirm a relationship.

No relationship exists between performance rating (question VI6) and activity levels.
"Helping" Job Related to Activity Levels

The first significant relationship discovered is between identifying "helping others as part of the job" (question V5) and the number of unique bulletin boards to which the respondent contributed. A respondent identifying herself as having as a job responsibility to help other users in the same general subject area addressed in the bulletin board system, contributes to an average of thirty-five unique bulletin boards (contrasted to the average of five per respondent.) This difference is significant at the 0.01 level, and the ANOVA summary is presented in Table 6-3.

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>5695.1</td>
<td>2</td>
<td>2847.5</td>
<td>5.972</td>
</tr>
<tr>
<td>Within Groups</td>
<td>944024.1</td>
<td>72</td>
<td>476.8</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>982626.3</td>
<td>74</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

This same group with help responsibilities also has a lower percentage of dicta reported than other groups. They report that only ten percent of their messages are dicta (not questions or answers), contrasting to the other groups reporting thirty-five to forty-five percent dicta. This difference is significant at the 0.05 level, and the ANOVA summary is presented in Table 6-4.

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>5464.6</td>
<td>2</td>
<td>2732.3</td>
<td>3.689</td>
</tr>
<tr>
<td>Within Groups</td>
<td>42221.3</td>
<td>57</td>
<td>740.7</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>47685.9</td>
<td>59</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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Although this group read over 121 unique bulletin boards each month versus less than half that level for the other groups, the significance of this difference is not supported by the ANOVA test.

**Bulletin Board Experts Are Active**

Respondents who indicated that they are experts on the electronic bulletin board system (question IV2) have the largest number of average unique bulletin boards read (178, nearly three times that of the other groups) and the largest number of average unique bulletin boards to which they contributed (almost 30, compared to less than three for the next largest group). ANOVA tests on both of these items are significant at the 0.05 level, with summary tables presented below. There is no difference between these bulletin board experts and other groups on percentage of dicta, though the experts average a bit fewer dicta than the other groups.

**Table 6-5: ANOVA for BB's Read / BB Expertise**

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>122717.8</td>
<td>3</td>
<td>40906.0</td>
<td>3.338</td>
</tr>
<tr>
<td>Within Groups</td>
<td>857793.5</td>
<td>70</td>
<td>12254.2</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>980511.4</td>
<td>73</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Table 6-6: ANOVA for BB Contributions / BB Expertise**

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>5417.2</td>
<td>3</td>
<td>1805.72</td>
<td>3.649</td>
</tr>
<tr>
<td>Within Groups</td>
<td>33651.9</td>
<td>68</td>
<td>494.88</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39069.1</td>
<td>71</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Similarly, the respondents who claim a "much greater" knowledge of the subjects discussed in the bulletin boards than the average participant (question IV3) contribute to more unique bulletin boards each month than groups responding otherwise (over 35 bulletin boards versus fewer than four bulletin boards.) The summary for the ANOVA test is shown in Table 6-7, which indicated a significant difference among the groups at the 0.05 level. This same group also reads more than twice the number of bulletin boards as any other group (126), but the ANOVA test fails to show this difference as significant.

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>6023.5</td>
<td>4</td>
<td>1505.89</td>
<td>3.011</td>
</tr>
<tr>
<td>Within Groups</td>
<td>33008.1</td>
<td>66</td>
<td>500.12</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>39031.7</td>
<td>70</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.4 CORRELATION OF DEMOGRAPHICS AND MOTIVATION

Four sets of motivational questions were chosen for comparison with demographic questions. The previous chapter shows high ratings for both stars and non-stars to the personal motivation of solving problems with the bulletin board system. Thus for the first motivation measure, the rankings for the three problem solving questions (III2b, III2c, III2g) are averaged to create a "problem solving" motivation score. Second, two questions relating to simply maintaining bulletin board subject awareness (III2a, III2d) are averaged for a "keeping up" motivation score. Third, question III2f, "helping others," is used for a "helping" motivation. And finally, question III3a, "success in solving problems," is used as the metric for a "success" motivation score. The ratings of the motivations are on a seven-point
scale; one is the highest score in the results presented below.

Again, for each possible answer to the demographic questions, statistics on the motivation scores are collected which are suitable to test differences between groups by an analysis of variance (ANOVA) test.

No Difference in Basic Demographics

No motivational differences exist among the groups differing in years of service (question VII). Similarly, no differences exist among job classifications (question VI4), although lower level respondents have slightly higher "problem solving" motivation and "success with problem solving." Nor are there motivational differences among respondents by performance rating (question VI6).

Expert Programmers Self Motivated

The first significant difference in this set of correlations is found by segregating the respondents by programming skills (question V3). Expert programmers believe "keeping up" is significantly more important than do other groups; the ANOVA summary is presented in Table 6-8, which is significant at 0.01.

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>9.227</td>
<td>3</td>
<td>3.0758</td>
<td>4.126</td>
</tr>
<tr>
<td>Within Groups</td>
<td>51.437</td>
<td>69</td>
<td>0.7455</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>60.664</td>
<td>72</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6-8: ANOVA for "Keeping Up" / Programmer Skill
Respondents with "Helping" Jobs Like to Help All

The next significant difference is not surprising; respondents who have job responsibilities in helping others with topics in the same general area as the electronic bulletin board system (question V5) rate "helping others" as a stronger motivation than other groups. The ANOVA summary is presented in Table 6-9, which is significant at 0.05.

**Table 6-9: ANOVA for "Helping Others" / Job of Helping**

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>20.590</td>
<td>2</td>
<td>10.295</td>
<td>3.611</td>
</tr>
<tr>
<td>Within Groups</td>
<td>208.102</td>
<td>73</td>
<td>2.851</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>228.692</td>
<td>75</td>
<td>------</td>
<td></td>
</tr>
</tbody>
</table>

Bulletin Board Experts Have Stronger Motivations

Experts on the bulletin board system (question IV2) are more motivated to personally "keep up" than other groups; experts average 1.06 (with one the highest) while other groups average a bit over two. Despite the narrowness of the difference, it is significant at the 0.01 level; the ANOVA summary is in Table 6-10.

**Table 6-10: ANOVA for "Keeping Up" / BB Expertise**

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>8.584</td>
<td>2</td>
<td>4.2923</td>
<td>6.929</td>
</tr>
<tr>
<td>Within Groups</td>
<td>43.365</td>
<td>70</td>
<td>0.6195</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>51.949</td>
<td>72</td>
<td>------</td>
<td></td>
</tr>
</tbody>
</table>

Respondents expressing a "much greater" knowledge of the subjects discussed in the bulletin boards than the average
contributor (question IV3) are also more motivated to personally "keep up." The difference among the respondents is significant at the 0.01 level, and the ANOVA summary is presented in Table 6-11. Fortunately, this same group with its greater knowledge is also more personally motivated to "help others," rating the motivation about two (one is highest) compared to all other groups which rate it at least three. This difference among the groups is also significant at the 0.01 level, and the ANOVA summary is presented in Table 6-12.

Table 6-11: ANOVA for "Keeping Up" / Relative Expertise

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>12.728</td>
<td>4</td>
<td>3.1819</td>
<td>4.727</td>
</tr>
<tr>
<td>Within Groups</td>
<td>45.778</td>
<td>68</td>
<td>0.6732</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>58.506</td>
<td>72</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 6-12: ANOVA for "Helping" / Relative Expertise

<table>
<thead>
<tr>
<th>Source of Variance</th>
<th>SS</th>
<th>df</th>
<th>MS</th>
<th>F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>44.025</td>
<td>4</td>
<td>11.006</td>
<td>4.335</td>
</tr>
<tr>
<td>Within Groups</td>
<td>172.655</td>
<td>68</td>
<td>2.539</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>216.680</td>
<td>72</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.5 CORRELATION OF MOTIVATION AND ACTIVITY LEVELS

Two of the activity levels, bulletin boards read and bulletin boards contributed, are compared with the four motivation scales, "problem solving," "keeping up," "helping others," and "success with problem solving." Since all measures are scalar, linear regression was used to seek correlations.
The null hypothesis for the tests of significance is that there is no relationship. The hypothesis is rejected if the possibility that no relationship existed is less than five percent; this is determined by the mean and standard deviation of the slope from the linear regression routines.

**No Relationships Discovered**

Under the above criteria, no significant relationships are discovered between motivation factors and activity levels. Indeed, rarely is a relationship even close to being significant.

The lack of a relationship in several particular areas merits further comment. There is no relationship between the motivation to "keep up" and the numbers of bulletin boards read or to which contributions were made. It seems that more activity would have been associated with respondents who wanted to maintain broader knowledge on the subjects addressed in the bulletin boards.

Similarly, a relationship between "problem solving" and activity levels would have been suspected. The lack of such a relationship is evidence that "problem solving" is a universal motivation, regardless of how many problems one must solve. To each participant, the bulletin board system is important for solving even his few key problems.

**6.6 SUMMARY**

Once again, the key results of the chapter are summarized.

1. **No difference exists in motivations or levels of activity based on the years of service, job classification, or performance ratings of the respondents.** As a group, the respondents are not distinguished on any of these metrics.
2. **Respondents with job responsibilities to help others are more active users of the bulletin board system than others.** This group is a natural user of the bulletin board system, as well, so this result is not surprising.

3. **Expert programmers, whom I suspect are the heaviest users from the previous results, are more motivated to "keep up".** The programming nature of the majority of the bulletin boards may make regular reading of the bulletin boards a necessity to retain expert programmer skills.

4. **The most skilled, knowledgeable bulletin board users have the highest activity levels, and show the strongest motivations to "keep up" and "help others."** This may be a simple tautology; for through heavier usage and a motivation to stay abreast of current technical happenings, the group would become the most knowledgeable and most familiar with the bulletin board system.

5. **Strong motivations to participate do not correlate with higher activity levels.**
7.1 THE BULLETIN BOARD SYSTEM OBSERVATIONS

The electronic bulletin board system of this study is larger than any other reported in the literature and is truly international in scope. The size of the specific bulletin boards in the system varies widely, as does the activity levels of individual participants.

The bulletin board system provides a forum for discussing technical matters; questions of a non-technical nature often lack bulletin board answers. The bulletin board system supports communication across both geographic and organizational boundaries, and no evidence was found that a site is more responsive to its own questions. Further, the survey results indicate that bulletin board participants almost never know any of their fellow participants prior to using the system.

For the participants, the bulletin board system provides an exceptional problem resolution mechanism. Not only is the system more effective than consulting local experts or using the reference material associated with the product under question, but the system is the first resource consulted when a problem arises. Since the order of reference is indicative of the social cost associated with the media, I conclude that the cost is low to reference existing material in the bulletin board system.

Satisfaction with the bulletin board system is high (not surprising considering the level of activity.) Questions placed in the bulletin board system frequently receive multiple replies, which presents multiple solutions or additional insights to the problem.
Most subjects relate to programming, particularly programming personal computers; thus the fact that expert programmers are the most active participants is not unanticipated. The study does not allow a causal relationship to be shown, however: On one hand, programmers are natural users of such systems and thus may choose to discuss programs; or on the other hand, since programming is the subject, programmers are more heavily involved in its discussions.

Most participants follow many topics in the bulletin board system, averaging over fifty unique subjects representing about ten percent of the total volume of information.

Contributors cite strong personal motivations for participation, much stronger than job-related motivations. This might be attributed to a lack of management awareness of the effectiveness of the system, or the difficulty in requiring someone to remain informed on a subject against his will. Especially strong for all participants is the personal desire to satisfy curiosity and to "keep up" on the topics.

As suggested by the literature [Chess and Cowlishaw, 1987; Feldman, 1986], the bulletin board system provides a repository for common questions and answers of general interest. The relatively equal numbers of questions and answers also attests to the use of the bulletin board as a repository. In the system, answers could have been sent directly to the originator of the question as easily as placing the answer in the bulletin board. Yet most participants prefer to answer through the bulletin board, suggesting strong mores to collect useful information for others. Indeed in several cases when pairing questions and answers in a sample of messages, the person asking the question provided the response, usually as a summary of the various replies she received to his original question.
No distinction was found among the classes of participants based on performance rating, although participants seem to have higher performance ratings than would be expected from an population from the company. Nor was any distinction found relative to years of service or job level.

7.2 DIFFERENCES AMONG PARTICIPANTS

The survey was the key vehicle used to provide distinctions among the participants. Suspecting participation level to be a distinguishing trait, the surveys were coded to identify heavy users (stars) versus others (non-stars).

Stars seem to perform an information-providing role for the entire group of participants. More of the stars' messages are tips and techniques (dicta) or answers to questions than are the messages of non-stars. The stars also cite a stronger motivation to "help others" as a reason for participation.

Stars appear to be the leaders of the bulletin board system in other ways. They participate more heavily than expected in "meta" bulletin boards which address the use of the bulletin board system itself, including mores discussions.

Stars tend to be expert programmers, as reflected by the bulletin boards in which they participate heavily, and by their own assessment of programming skills in response to the survey. Probably as a result of their higher participation levels, stars feel they have more knowledge of the bulletin board system itself.

Through the use of the bulletin board system, stars establish more new regular contacts than non-stars. Stars reported over seven new contacts with whom they regularly communicate with direct electronic mail.
Analyses of the survey data revealed other trends among participants, although most related to programming expertise which I noted above as being a characteristic of stars. Expert programmers tend to be more motivated to "keep up" on bulletin board topics, probably to retain and hone their skills.

Experts on the use of the bulletin board system tended to have the highest activity levels, both in the number of bulletin boards read and the number of bulletin boards to which they contribute. This seems to be a self-fulfilling prophesy.

As mentioned above, there was a lack of trends based on the participants job performance, job level, years of service with the company, or years of experience with computers. Hence, there does not seem to be any "entry" barriers to becoming a participant, a positive characteristic of the system.

7.3 BULLETIN BOARD PARTICIPANTS AS GATEKEEPERS

Electronic bulletin board system of this study provides ready access to large amounts of information as well as to a set of worldwide "experts." Yet access does not imply use. Access to technical journals abounds, but few professionals actually read them regularly. The majority seek advice from those few information "gatekeepers" [Allen, 1977].

A similar situation could be evolving in the electronic bulletin board system of this study. Several factors contribute to this expectation. First, expert programmers with job responsibilities in the subject area of the bulletin board dominate the use of the system. While programmers are a significant portion of the company work force, their numbers are disproportionate with their involvement in the bulletin board system.
Second, recall that Hiltz and Turoff [1985] suggest that bulletin board users must develop system skills to effectively utilize a large system subject to information overload. Programmers naturally develop such skills for their profession, and are capable of developing their own filtering tools in addition to those offered by the system. The need for system skills may effectively block general access to the system. This is analogous to the technical gatekeeper situation, in which peers are unable to "keep up" with the literature but are capable of reading and understanding relevant articles once such articles have been identified.

Following the technical gatekeeper analogy one step further, the participants in the electronic bulletin board system may be referring their colleagues to the particular bulletin board necessary to solve their problem. Without the participant present, the colleague can read and study the identified information at his leisure. Such references are efficient; the participant can identify a bulletin board and relevant keyword to the inquirer with a brief electronic mail message.

And recall that the participants, especially the stars (frequent communicators), perceive "helping others" as a primary personal motivation for using the system, consistent with the gatekeeper model.

Thus, the participants have broad access to outside information and contacts, the skills to effectively use this resource, and a basic desire to assist others. These are strong indicators of a gatekeeper system. Only one bit of evidence is lacking to support the claim that these participants are gatekeepers. I require confirmation that the participants' colleagues do not first reference the electronic bulletin board system themselves, but initiate their questions through the participants, and that question has not been addressed by this study.
But assuming that the electronic bulletin board system of the study is suitable for use only by gatekeepers, is this a problem with the system? In my opinion, not necessarily. Gatekeeper networks seem to be effective information distribution vehicles once established. The professionals in the organization may not wish to universally access and use the bulletin board system on a regular basis, anymore than they will start to read their professional journals regularly. Perhaps the administrators of the bulletin board system should concentrate of features which support technological gatekeepers in disciplines broader than programming rather than attempting to bring the entire organization into the system as active users. This direction is consistent with urgings of Hiltz and Turoff [1985] to court the experienced users.

7.4 AREAS FOR FURTHER STUDY

Many questions in this area remain unanswered, and more have surfaced as the study unfolded. In this section, several key areas of suitable for complementary study will be discussed.

Besides the use of the bulletin board system, communication among the participants is largely unexplored. This study reveals no biases for frequent contributors to respond more often to other frequent users within the bulletin board system. New contacts seem to have been established, though. The frequent participants reported over seven new regular contacts on average. How are these contacts maintained? A survey for participants could further explore the nature of these contacts.

The relationship between the participants and their colleagues remains unknown, preventing this study from reaching firm conclusions on the question of participants as gatekeepers. Surveys could be distributed to members of a
participant's department to explore his role in his own organization. Of course it is possible for a participant to serve as a gatekeeper for the bulletin board system itself, servicing user questions by direct electronic mail exchanges or through the bulletin board.

This study does not address persons who only read the bulletin boards, but do not participate. Much is not known about these readers, including their actual number which has been estimated from 20,000 to 90,000. The same basic survey could be distributed to these readers and provide a source of comparison between participants and readers. Readers could easily be gatekeepers themselves by regularly reviewing bulletin boards to "keep up." If readers find the bulletin board system useful, why do they not take the next step and participate? Are there system or psychological barriers which need to be addressed?

The system is available to an even broader audience of over 250,000 network users. Does this broader population know about the system, and would they have a use for it?

Should the system bother to address the needs of the entire organization, or should it simply address the needs of technology gatekeepers as suggested above?

Finally, this study does not explore the specific positive rewards contributors receive for participation. Altruism could be the primary motivation, but their seeking of recognition by colleagues is equally plausible. Or a participant may feel compelled to answer the questions of others in order to build up "credit" to get her own question answered in the future.

Personal computers, the predominant subject of the bulletin board system, could be a hobby of the participant. This seems to be the case for some participants who provide programming tools developed on their own time for distribution
through the parallel tools distribution system; the tool writers often establish a bulletin board to discuss the tool's use and problems. These tool writers could be seeking a fertile test environment for their applications which they intend to market for profit, or simply seeking recognition by peers of their skills.

7.5 CONCLUDING REMARKS

The particular electronic bulletin board system of this study must be considered an overwhelming success based on the results of this study. It meets the requirements of a good system as described by Feldman [1986] and Hiltz and Turoff [1985]. Communication barriers have been effectively eliminated, and strong social mores have formed to support self-policing of the topics. The bulletin board system is a growing entity, with significant amounts of new knowledge being created and added daily.

The bulletin board system provides a powerful communications vehicle for its participants, allowing them free access to the opinions of experts throughout the world. It even seems to have served to introduce people of similar interests who would not have otherwise known of each other. Such new contacts must surely build new synergism within the organization if the results of Pelz and Andrews [1976] and Allen [1977] are extrapolated into this environment.

A technology of great promise has delivered on that promise.
ACKNOWLEDGEMENTS

I would like to gratefully acknowledge Tom Allen, my thesis advisor, for the inspiration, advise, and encouragement he gave me as this thesis was developed. Also, I would like to acknowledge Tom Malone, my thesis reader, for his key guidance in discovering the relevant literature in the area.

I also appreciated the timely advise of Arnie Barnett as I encountered several sticky statistical questions. His advise was instrumental in selecting the proper tests of relevance when I went astray.

Finally, I would like to acknowledge the Dave Chess, Gloria Whittico, and Jerry Waldbaum of IBM Research in Yorktown Heights for their assistance and cooperation in pursuing this study.
APPENDIX A: SURVEY

The following is the questionnaire used for the survey discussed in Chapters 5 and 6. The text and format differs different than that actually used: First, the text has been edited to use terminology consistent with that of this thesis; for example in the original, the company name for the electronic bulletin board system is used when asking questions concerning it.

Second, a smaller type was used for the distributed survey to allow the survey to be completely printed on both sides of only three pages. This was thought necessary to keep the appearance of the survey as "short" to encourage immediate replies. The resulting return rate of 85 percent was quite satisfactory.
I. ELECTRONIC BULLETIN BOARD SYSTEM AWARENESS AND USE

1. Are you familiar with the electronic bulletin board system?
   ( ) Yes
   ( ) No - Skip to Section V.

2. Do you read (or skim) the electronic bulletin boards?
   ( ) Yes
   ( ) No - Skip to Section III.

3. How often do you read the electronic bulletin boards?
   ( ) Almost every day
   ( ) Couple of times per week
   ( ) About once a week
   ( ) Couple of times per month
   ( ) About once a month
   ( ) Less than once a month

4. How many **different** electronic bulletin boards would you typically read (or skim) at least once a month?
   __________ unique bulletin boards per month
   (number)

5. Do you ever contribute (append text) to the electronic bulletin boards?
   ( ) Yes
   ( ) No - Skip to next Section

6. How often do you contribute to the electronic bulletin boards?
   ( ) Almost every day
   ( ) Couple of times per week
   ( ) About once a week
   ( ) Couple of times per month
   ( ) About once a month
   ( ) Less than once a month

7. To how many **different** electronic bulletin boards would you typically contribute at least once a month?
   __________ unique bulletin boards per month
   (number)
II. CONTRIBUTORS: TYPES OF CONTRIBUTIONS

Complete this section only if you indicated you make contribution to the electronic bulletin boards in Section I. Otherwise, skip to the next Section.

1. Have you ever placed a question into an electronic bulletin board?
   ( ) Yes
   ( ) No - Skip to Question 8

2. Recall the last question you placed into an electronic bulletin board. Did you receive any answer by any means?
   ( ) Yes
   ( ) No - Skip to Question 8

3. How many answers did you receive (counting duplicates as multiple answers)?
   ------------
   (number)

4. Check all the ways by which you received an answer:
   ( ) Appeared in the electronic bulletin board
   ( ) Sent directly to me electronically by another online user
   ( ) Received phone call from a user
   ( ) Received personal visit from a user

5. By which way did you receive the first answer?
   ( ) Appeared in the electronic bulletin board
   ( ) Sent directly to me electronically by another online user
   ( ) Received phone call from a user
   ( ) Received personal visit from a user

6. By which way did you receive the best answer?
   ( ) Appeared in the electronic bulletin board
   ( ) Sent directly to me electronically by another online user
   ( ) Received phone call from a user
   ( ) Received personal visit from a user

7. Was the best answer satisfactory (meet your need, or explain clearly how it was impossible to meet)?
   ( ) Yes
   ( ) No

8. Have you ever answered another user's question which you had read in an electronic bulletin board (answering by any means)?
   ( ) Yes
   ( ) No - Skip to Question 10
9. Which way did you give the answer (if you answered several ways, just indicate the first way you answered)?
   ( ) Placed an answer in the electronic bulletin board
   ( ) Sent answer directly to the user electronically
   ( ) Answered the user by a phone call
   ( ) Answered the user by a personal visit

10. Have you ever made a contribution to an electronic bulletin board, not to ask a question or append an answer, but rather to simply add to the knowledge of the bulletin board or to participate in a running "conversation" on a topic of interest to you?
    ( ) Yes
    ( ) No - Skip to next Section

11. What percentage of your contributions would fall into this "conversation" category (as opposed to "questions" or "answers")?
    _________ percent
    (number)
III. USERS: REASONS FOR USAGE

Complete this section only if you indicated you are aware of the electronic bulletin boards in Section I.

1. How important are electronic bulletin boards to your current job (as your manager sees it)? Circle on the scale the degree of importance.

<table>
<thead>
<tr>
<th>Reason</th>
<th>Very Important</th>
<th>Not Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Keep up with bulletin board topics</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>b. Solve a particular technical problem</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>c. Solve a particular non-technical problem, like the price of a product</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>d. Satisfy your curiosity on a subject</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>e. Seek product reviews and comparisons</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>f. Help users less experienced in a particular subject</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>g. Get help from more experienced users</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>h. Reach specific people</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>i. Tap group knowledge to come to decisions</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>j. Generate new ideas through peer discussion</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>k. Maintain a bulletin board (I am an owner)</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>
2. How important are electronic bulletin boards to **you personally**? Circle on the scale the degree of importance.

<table>
<thead>
<tr>
<th></th>
<th>Very Important</th>
<th>Not Important</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Keep up with bulletin board topics</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>b.</td>
<td>Solve a particular technical problem</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>c.</td>
<td>Solve a particular non-technical problem, like the price of a product</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>d.</td>
<td>Satisfy your curiosity on a subject</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>e.</td>
<td>Seek product reviews and comparisons</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>f.</td>
<td>Help users less experienced in a particular subject</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>g.</td>
<td>Get help from more experienced users</td>
<td>1 2 3 4 5 6 7</td>
</tr>
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<td>h.</td>
<td>Reach specific people</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>i.</td>
<td>Tap group knowledge to come to decisions</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>j.</td>
<td>Generate new ideas through peer discussion</td>
<td>1 2 3 4 5 6 7</td>
</tr>
<tr>
<td>k.</td>
<td>Maintain a bulletin board (I am an owner)</td>
<td>1 2 3 4 5 6 7</td>
</tr>
</tbody>
</table>
3. How **successful** has your use of the bulletin boards (reading or contributions) been? Circle on the scale the degree of success. Do not answer items which do not apply, like getting answers to questions when you have never asked any.

<table>
<thead>
<tr>
<th></th>
<th>Very Successful</th>
<th>Never Successful</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Receiving answers to my questions in electronic bulletin boards</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>b. Finding product reviews I was seeking</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>c. Solving other electronic bulletin board users problems</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>d. Solving problems for others in my department or function</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>e. Gaining feedback on new ideas</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
<tr>
<td>f. Gaining feedback on new products (including your own)</td>
<td>1 2 3 4 5 6 7</td>
<td></td>
</tr>
</tbody>
</table>

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4. Think about the most recent computer problem you had. Try to recall the order in which you used the following channels to solve it. Rank them in the order of use, but do not rank those you did not use. (Indicate by placing "1" in the first, "2" in the second, etc.)

( ) Seek an answer in existing electronic bulletin boards

( ) Place a question in an electronic bulletin board

( ) Figure it out by trial and error and the manuals

( ) Ask the local computer "expert"

( ) Ask another user with similar skill as your own

5. Think about the most recent computer problem you had. Try to recall the effectiveness of each of the following channels you used to solve it. Rank them in the order of effectiveness, but do not rank those you did not use. (Indicate by placing "1" in the first, "2" in the second, etc.)

( ) Seek an answer in existing electronic bulletin boards

( ) Place a question in an electronic bulletin board

( ) Figure it out by trial and error and the manuals

( ) Ask the local computer "expert"

( ) Ask another user with similar skill as your own
IV. PERSONAL INFORMATION: BULLETIN BOARD BACKGROUND AND IMPACTS

1. How long has it been since you first used the bulletin boards?
   ( ) Less than 3 months
   ( ) 3-6 months
   ( ) 6-12 months
   ( ) 1-2 years
   ( ) >2 years

2. How much do you know about the electronic bulletin boards?
   ( ) I'm an expert on electronic bulletin boards
   ( ) I'm quite knowledgeable
   ( ) I'm about average
   ( ) I don't know very much about it
   ( ) I know little or nothing about it

3. Compared to the average contributor, would you say that your
   knowledge of the subjects discussed on bulletin boards is on the
   whole:
   ( ) Much greater
   ( ) Somewhat greater
   ( ) About the same
   ( ) Somewhat less
   ( ) Much less

4. Of the people with whom you communicate via the bulletin boards, how
   many did you know previous to using the bulletin boards?
   ( ) Almost none (less than 10%)
   ( ) Between 10 and 40 percent
   ( ) About half (40-60%)
   ( ) Between 40 and 80 percent
   ( ) Almost all (more than 80%)

5. Of the people you have "met" through the electronic bulletin boards,
   with how many do you now regularly (about once a month) communicate?
   a. Directly in person: _________
      (number)
   b. By phone: _________
      (number)
   c. By electronic mail: _________
      (number)

6. How much impact does geographical location have on with whom you can
   communicate through bulletin boards?
   ( ) A very large impact
   ( ) A moderate impact
   ( ) A small impact
   ( ) No impact

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7. How did you originally learn to use the electronic bulletin board system?
   ( ) From electronic bulletin board notices online
   ( ) From an official class
   ( ) From other users
   ( ) From computer system user support
   ( ) By trial and error on my own
   ( ) Other __________________

8. Is following or using the electronic bulletin boards part of your job requirements?
   ( ) Yes
   ( ) No
V. PERSONAL INFORMATION: COMPUTER EXPERIENCE

1. How long has it been since you first used a computer?
   ( ) Less than one year
   ( ) One to five years
   ( ) Six to ten years
   ( ) Eleven to twenty years
   ( ) More than twenty years

2. How skilled a computer user do you consider yourself?
   ( ) Expert
   ( ) Quite knowledgeable
   ( ) Average
   ( ) Inexperienced
   ( ) Total novice

3. How skilled a programmer do you consider yourself?
   ( ) Expert
   ( ) Quite knowledgeable
   ( ) Average
   ( ) Inexperienced
   ( ) Total novice

4. Do you program a computer as part of your job?
   ( ) Yes, an IBM PC (or XT, AT, clone, etc.)
   ( ) Yes, but not an IBM PC or clone
   ( ) No

5. Do your job responsibilities include Computer Information Center or Education functions (helping others learn and use personal computers)?
   ( ) Yes
   ( ) No, but I do it anyway
   ( ) No

6. Do you have access to the bulletin boards from home?
   ( ) Yes
   ( ) No
VI. PERSONAL INFORMATION: YOUR JOB AREA

1. How many years have you worked for this company?
   ( ) 0-5 years
   ( ) 6-10 years
   ( ) 11-15 years
   ( ) 16-20 years
   ( ) 21-25 years
   ( ) more than 25 years

2. In what general area is your job?
   ( ) Research
   ( ) Development
   ( ) Marketing
   ( ) Manufacturing
   ( ) Administrative/Personnel
   ( ) Finance
   ( ) Other (please specify) ______________________

3. Are you a manager?
   ( ) Yes
   ( ) No

4. (Optional) What is your current job title (e.g., staff programmer, senior associate engineer, etc.)?
   ______________________________________
   (title)

5. (Optional) When was your last promotion?
   _______ _______
   (Month) (Year)

6. (Optional) What is your current performance rating?
   ( ) Far Exceeds (1)
   ( ) Exceeds in All Key Areas (2)
   ( ) Consistently Exceeds (3)
   ( ) Meets Requirements and Occasionally Exceeds (4)
   ( ) Not rated
APPENDIX B: DATA BASE STRUCTURE OF STUDY

The data for the thesis was entered into a dBase III Plus (t) data base management system licensed by Ashton-Tate. Below is a description of the data bases in which the information was stored to enable a future researcher to compare his results to mine. A copy of the data base has been left with my thesis advisor, Professor Thomas J. Allen, and I will also retain a copy of the data base for three years.

The data base is relational; that is, items related to each other are stored in separate files, with pointers indicating related information in other files. For example, a record of each message exists in the MESSAGES file with a single field in that record indicating which user. The USERS file to which that field points has information on the user's location and usage frequency.

MESSAGES File

The MESSAGES file has a single record for each message appended to the electronic bulletin board system in October 1986. The fields are:

FORUM Name of the bulletin board
MESSDATE Date for message
MESSTIME Time in GMT for message receipt
MESSLEN Number of non-blank lines in message
USERNUM Assigned number of user appending message

FORUMS File

The FORUMS file has a single record for each bulletin board in the system. The fields are:
FORNAME  Name of the bulletin board
MESSCNT  Number of October messages in BB
MESSLEN  Total October non-blank lines in BB
USERCNT  Total unique October contributors to BB
GKCNT    Number of messages from stars in BB
USCNT    Number of messages from U.S. users in BB
FORTYPE  Code reflecting type of bulletin board
          (H=hardware, P=software, T=technical,
           C=concept, N=non-technical, L=locator,
           X=missing)

 USERS File

The USERS file has a single record for each participant in the bulletin board system in October. The fields are:

USERNUM  A sequential number assigned to each user
NODE     Name of the computer node for that user
MESSCNT  Number of October messages for the user
MESSLEN  Total non-blank lines in October messages
FORUMCNT Number of unique BB's user participated in

 NODES File

The NODES file has a single record for each computer node which had users who contributed to the bulletin board system in October. The fields are:

NODE     Name of computer node
SITENUM  Record number for node's site in SITES
MESSCNT  Number of October messages from that node
MESSLEN  Total non-blank lines in October messages
FORUMCNT Number of unique BB's contributed to
USERCNT  Number of October participants at node
SITES File

The SITES file has one record for each company site which contributed messages in October to the bulletin board system. The fields are:

SITE City and state (country) of site
US Logical flag indicating if site is in U.S.
MESSCNT Number of October messages from that site
MESSLEN Total non-blank lines in October messages
FORUMCNT Number of unique BB's contributed to
USERCNT Number of October participants at site
NODECNT Number of nodes at site

SAMPLE File

In Chapter 4, a random sample of messages was taken and classified. For each message, a record in a SAMPLE file was created. Note that the fields starting with "O" are the corresponding answer/question to the selected message, and exist only if the corresponding answer/question was located. A test for existence is best done on the OMESSID field. The fields in the SAMPLE file are:
MESSID  Message number of message in MESSAGES
USERNUM  Number of user appending message
NODE  Name of node of that user
SITENUM  Number of record in SITES file for message
QA  Message classification:
(Q=question, A=answer, D=dicta, X=missing)
TN  Message classification:
(T=technical, N=non-technical, X=missing)
GK  Classification of message appender:
(GK=star, NG=non-star)
US  Classification of message appender:
(US=U.S., FR=non-U.S.)
OMESSID  Corresponding A/Q message number
OUSERNUM  Corresponding A/Q user number
ONODE  Corresponding A/Q node name
OSITENUM  Corresponding A/Q site number
OGK  Corresponding A/Q user classification
OUS  Corresponding A/Q user classification

SURVEY1 File

For the survey used in Chapters 5 and 6, surveys were distributed to all the stars and a random selection of non-stars. The SURVEY1 file has one record for each user to whom a survey was sent; only U.S. participants were surveyed. Note that this database contained the name and internal mailing address for each person surveyed; this data is not available as it is company sensitive. Thus, the only field is:

USERNUM  Number of user to whom survey was sent

RESULT1 and RESULT2 Files

The results of the survey are coded into two files; RESULT1 has the data for the survey used in Chapter 5, and RESULT2 has the data for the survey used in Chapter 6 which is
a subset of the records from RESULT1. There is one record per questionnaire returned, and the individual questions have been coded into fields in several ways.

The field names correspond to the question numbers. For example, the rating requested in section III, question 1a, is in a field named III1A. For multiple choice questions which allowed multiple answers, a separate field was created for each possible answer. For example, the rank of the third item in section III, question 4, is in a field named III4c, where "c" represents the third item.

The coding of a question having a yes/no answer is either as a single character (Y=yes, N=no, blank=not answered) or a logical value (true=yes, false=no or not answered). For questions involving selecting a single item from a list of multiple choices, the item number is coded (1 for first, 2 for second, etc.), with zero (0) representing no answer given. Ranking questions simply have the rank coded, again with zero (0) representing no answer. For questions requiring a numerical estimate, that value is coded, with minus one (-1) indicating no answer.

In addition to the normal questions, there are three additional fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>VI4A</td>
<td>Job level coding</td>
</tr>
<tr>
<td>VI5A</td>
<td>Months since last promotion</td>
</tr>
<tr>
<td>GK</td>
<td>Logical indicator, true = star respondent</td>
</tr>
</tbody>
</table>

VI4A when added to performance rating (VI6) approximates a salary metric.
REFERENCES


Granovetter, Mark S. The Strength of Weak Ties. American Journal of Sociology 78, 6 (June 1986). 1360-1380.


