COMPUTERIZED CONFERENCING & COMMUNICATIONS CENTER

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Development and Field Testing of an Electronic Information Exchange System: Final Report on the EIES Development Project

by

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ABSTRACT

The Electronic Information Exchange System (EIES) is a particular design of a computerized conferencing system intended to allow both the facilitation of scientific and technical communications and experimentation and research into human information-communication processes. To meet the first objective EIES offers functional components of messaging, conferencing, notebooks and bulletins for its users. To meet the second objective EIES allows for the tailoring of interfaces by individuals and groups, and the incorporation of special processing and interconnect options to other computer and information systems.

EIES is designed as a research tool or laboratory without walls in order to allow information scientists and those in related fields to observe, evaluate, experiment with and investigate the utilization of such systems by individuals and groups.

During the test period EIES was utilized by about 200 individuals. Approximately 10,000 hours of usage occurred, 40,000 items of text were composed and over 123,000 items of text delivered. This comprised approximately 2 million lines of text communicated among the user population. The initial results demonstrate very different behavior patterns for individuals than exhibited by other types of interactive systems.

By a process of induction from the various types of data collected during the pilot project, a number of conclusions were arrived at, stated in the form of a list of hypotheses for further testing.

The results of this grant are:

1) The development of an operational system.

2) Initial concepts on evaluation, utilization and experimentation with this type of system.

3) Test usage and observation of usage over a one year period, comprising the single largest experiment with any computerized conferencing system to date.

4) Numerous papers were published and professional presentations made.

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While the authors of this report take the responsiblity for style and content, the EIES development project could not have succeeded without those who did a great deal of the actual work. These were: Alan Leurck, James Whitescarver, James Grover, Dave Harvey, John Howell, Anita Rubino and Thomas Featheringham.

PERSPECTIVE: Goals and Historical Overview of the EIES Project

In the summer of 1975 the New Jersey Institute of Technology was awarded a grant by the Access Improvement Program of the Division of Science Information of NSF. The objectives of the grant were:

1) To design and implement a computer-communication system which would enhance the ability of a group of scientists to regularly communicate about current research activities and findings.

2) To develop evaluation procedures and tools applicable to understanding both the appropriateness for and the impact of this form of communication upon scientific communication.

3) To provide the Access Improvement Program of DSI with whatever information was needed in developing their own plans for obtaining user groups through an NSF announcement.

4) To pilot test both the system and evaluation instruments.

5) To promote awareness of the effort among communities concerned with scientific communications.

The design specifications for the system were developed and published in August of 1975 as Research Report Number One of the Computerized Conferencing and Communications Center at NJIT. This design was the result of reviewing previous computerized conferencing systems and evaluating proven features as well as incorporating new design features desirable for scientific user groups. The major portion of the first twelve months (from August '75 to August '76) was spent in the implementation of the software, representing a five person year effort, and on the incorporation of additional equipment. The system was planned and implemented as a dedicated mini-computer operation. This had the objectives of:

Providing computer-communication services at 50% or less of what appears to be the cost on current commercial time sharing systems.

Allowing a predictable response rate for the user at the terminal because all users of the hardware are utilizing the same software package.

Providing the reliability and security which individuals expect from a communication service.

As of October 1976, the system entered the pilot test phase, and has provided service to over 200 users in the period through September of 1977. The pilot system provided service in terms of messaging, conferencing and word processing.

In June of 1976 the central computer was tied into the TELENET digital packet network, so that users would be able to gain access by making local calls to any of some ninety major cities in the United States.

Parallel to the implementation effort, the effort to establish evaluation procedures had proceeded on schedule. The pilot use of the system provided a test of the design principles and evaluation instruments developed under this task. Further details on the implementation and the evaluation are to be found in the appropriate sections of this report.

Based upon the pilot trials over the period of September 1976 to September of 1977, considerable redesign of the user interface occurred and a great many special features were added to the system. These changes were incorporated in the summer of 1977. Many of the advanced features such as "procedures" were the result of research findings under a separate grant from the Division of Mathematical and Computer Sciences. The basic features included in the final design are described in the user information brochure called "How to Use EIES", contained in the Appendix to this report. Advanced features are noted in a one page guide and described in on-line explanations.

In addition to the formal effort, an attempt has been made to make individuals aware of the project and to engage in discussions with parties who might represent likely user groups. Furthermore, a number of papers have been published and presentations made as a result of this effort. These are abstracted in a separate section of this report.

The EIE test facility is specifically meant to augment four primary aspects of scientific and technical information exchange that involve a considerable amount of human communication. These are:

Recent Research Findings and Peer Group Exchanges

The process of mail, phone, travel and professional meetings all carry with them delays and characteristic inefficiencies that have grown rather than decreased in recent years. Both the rising costs of travel and the greater needs of multidisciplinary and/or interdisciplinary research make these informal and semiformal communication and exchange processes somewhat inadequate. Many research communities are finding the members rarely have professional meetings in common.

Joint Authorship and Joint Efforts

Unless authors and/or team members are in the same location this is a rather difficult and time consuming operation. Certain types of efforts like the implementation of a computer model are almost impossible to undertake unless the key members of the team are colocated. Furthermore, it is somewhat common today to find researchers who have discovered that the fellow researchers they most relate to are located elsewhere than their home institution.

Refereeing

The time delay in getting a paper reviewed and often re-reviewed prior to publication is well known to us all. For many areas of professional activity, this can take a year or more.

Evaluation

This is perhaps the area that has received the least attention in current efforts at improving scientific information flow and transfer. How often have we retrieved an article based upon an examination of title, abstract and/or index keys only to discover it was not what was expected? Where was the mechanism for the reader to update the system, indicate an appropriate change in the title, abstract or keys, so that others would have a better chance for a more relevant search with respect to the particular item? As important as the original article are the later reviews of or reactions to it published elsewhere or merely passed among the scientific group. Even if published, these are not well correlated with the original reference in most information retrieval systems.

Current efforts at improving journal production and the retrieval of Abstracts and published material have not aided the above pre-publication and post publication processes, which account for a significant delay time in many scientific and technical fields. The characteristics of EIES described in the next section

are meant to facilitate the removal of the above bottlenecks.

It has also become apparent from our investigations and experience with EIES that it holds the potential of being an important communications factor in the support of secondary scientific activities. Among these are: standards committees; advisory committees; peer review processes; consulting; technology transfer efforts; technology assessment studies; R&D management or research priority setting and scientific educational efforts. In order to establish the effectiveness of some of these particular applications, it may be desirable to conduct controlled experiments rather than the current field trial approach. Certain of these applications might require some additional software support as exemplified by a specialized data structure within the EIES notebook for a standards setting working group. For controlled experimentation into information exchange processes, EIES offers the ability to tailor the interface and capabilities by individuals and groups.

EIES CHARACTERISTICS

The system itself may be viewed as a large common blackboard available to scientific users of the system regardless of their location or their preferred time of use. The blackboard has been subdivided into four major segments which offer the different components necessary for communication and information exchange among a group of professionals. These are:

> A personal NOTEBOOK where an individual can leisurely compose material for later use elsewhere in the system, and where he or she can invite others to coauthor short papers or reports.
>
> A private MESSAGE system where an individual can send a private communication to any other individual or set of individuals, such as a group.
>
> A CONFERENCE system where a group of MEMBERS can hold a common discussion around a specific topic and maintain a proceedings for later reference and reflection.
>
> A BULLETIN where an author or coauthors can submit a short paper or recent findings for review through direct conferences among anonymous referees and the authors. If accepted, such papers are considered public and placed in the BULLETIN. The BULLETIN is similar in concept to research newsletters which are published by some professional societies for the benefit of special interest groups.

The system is designed to provide regular and current communication facilities for a group. It is not designed as an archival system for historical records or for the production of large documents.

There is also a directory of users or members of EIES, into which each user is asked to enter his address, telephone number and a brief description of interests for the benefit of other users. The directory also allows the description and membership listing of groups, where a "group" is a set of members engaged in some common purpose or objective. A user can belong to more than one group. Normally a group has associated with it a private group conference or discussion. The group may also have its own bulletin or "newsletter" in which to publish material it wishes to make public.

The message file has a finite size which will be adjusted so that delivered messages will disappear approximately three months after delivery. A sender or receiver of a message may choose to copy the message into his or her notebook if desired. The sender may also initiate a termination of a message at any time.

A conference set up for an established group will maintain a proceedings that is normally up to three hundred comments long. This may be adjusted in special cases to be larger. Normally, the oldest comments will disappear to make room for new ones, once 300 or the adjusted maximum length has been reached. The individual moderating or facilitating the conference has the ability to selectively delete comments. The author of a particular comment may also date or delete that comment. This means that conference groups can selectively determine what is outdated.

A temporary conference, which can be set up by any user, is normally allocated space for fifty comments, which may also be adjusted by a request to the system monitor. Such conferences will be automatically deleted if a minimum level of activity, as defined by the system monitor, is not maintained. A particular user may normally have only one temporary conference in existence at any one time. The user setting up the temporary conference designates who are the other conferees. If the conferees wish to pool their allocations for temporary conferences, the system monitor would increase the allowance on conference size.

There are also a number of public conferences which do not maintain a membership list and are therefore open for anyone to access and make comments. Typically, this facility would be used for describing problems with the system or offering suggestions for improving the system or for discussions of general interest to members of many groups on the system.

Each user is normally allocated a hundred page notebook. This may also be adjusted by the System Monitor when a special need arises. A set of two or more users may merge this allocation into one. In addition, the owner of a notebook may make portions of his or her notebook available to others for reading and writing or reading only. The notebook is basically a personal file for retaining copies of items and for developing items at leisure, such as comments for a conference or papers for the bulletin.

The Bulletin will not be made available to the first scientific communities until early 1978, when all four initial user groups have gotten their members active on EIES and chosen a Bulletin editor. At that time, the user communities themselves, having become familiar with the system and its relation to their communication needs, will participate in making the final design decisions for the BULLETIN features. However, its basic mode of operation has been set.

The bulletin will be designed for short papers on current research activities (in the range of five to twenty pages, although this is not a hard and fast rule). There is to be an automatic procedure to submit a paper for review. Until accepted the paper will remain in the user's notebook, where it may be modified until the review procedure is complete. The reviewers chosen by the bulletin editor are to be given access to read the paper and can engage in an anonymous discussion with the author or authors through a temporary conference set up for that purpose.

The bulletin will allow members of the research group to submit news items or items that can be voted upon, with the vote displayed to the readership. This might be the statement of a research hypothesis, with a group response as to the degree of agreement; or a proposal for an experiment, with potential significance evaluated by the group. The author may select from some nine available voting scales. In addition, direct comments on submitted items or papers may be

contributed and will be automatically associated with the original item, for those wanting to retrieve the commentary on such items.

In addition to being a user or member of EIES and a member of different groups, certain individuals have the following roles:

The "editor" of the bulletin for a group;

The "coordinator" of a group, who may add or delete members of the group;

The conference "moderator," who can act as the chairman of a meeting through his or her editing powers, or merely act as a secretary in keeping the "minutes" or proceedings organized.

The "system monitor," who establishes the existence of members, notebooks and groups, and who can adjust the sizes allowed for conferences and notebooks;

The "user consultants," who are available for aid in learning to utilize the system or some of its advanced features.

The system provides four modes of interaction which may be used singly or in combination:

The straightforward menu selection - i.e., selecting an option from a list of choices;

An anticipatory mode, where a user can answer menu choice questions ahead of time and avoid being asked a series of questions to accomplish something;

A command mode which provides all the options in the menus and then advanced features as well;

A procedure mode, where the advanced user can define his or her own commands by storing under labels preset answers to operations he or she often performs.

The system also provides a number of elementary editing features for quick error corrections as well as some advanced ones for automatically formating tables, centering items, etc.

There also exists a programming capability which a few users have learned. It allows retailoring of specialized interfaces as well as the automatic collection of data via form fillouts from other users of EIES.

The system is designed in a segmented manner so that the user need only learn the minimum necessary to do specific things such as composing, sending and receiving messages. An on-line explanation file allows the user to learn about advanced features as the need arises. The basic operations of composing, sending and receiving items can gradually be learned by someone with no computer background in less than an hour of practice. The system, hopefully, forgives all errors and allows a trial and error approach to learning.

Specifically in terms of the problems of Scientific Information, EIES will allow a group of researchers to work together on a day to day basis regardless of geographic location and individual time constraints, since it does not require the time coincidence of phone conversations. The timely exchange of research findings or views, and the resolution of differences can proceed as quickly as desired by the group. Joint authorship becomes a painless procedure with respect to the mechanics of the process. Actual projects can be undertaken by a dispersed team. Refereeing can now involve direct discussions between authors and referees by utilizing PEN NAMES for the referees. Reviews and critiques of published items can be rapidly disseminated. At least, these items seem feasible within the design of EIES. What cannot be stated so firmly is that research groups will take advantage of these facilities. We do not accurately know at this time the characteristics of a research group that make it want to or not want to take advantage of EIES type capabilities, and likely or unlikely to be able to achieve their objectives by using the system. It is, however, the intent and purpose of the NSF announcement and the experimental program established by the Access Improvement Program* to try to gain insight into these factors.

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*NSF Announcement: Operational Trials of Electronic Information Exchange for Small Research Communities (NSF-76-45)

TECHNICAL OVERVIEW OF EIES

The system is comprised of two INTERDATA 7/32 mini-computers, each connected via a separate disk controller to a disk system with over 300 million bytes capacity. Only one of the processors is utilized to operate EIES. The other is utilized for research and computer science educational activities. However, it can be utilized to take over the operation of EIES if a problem develops with the other processor. The EIES utility processor has approximately half a million bytes of core. One half the core is sharable with the second processor. Either processor can access the disk storage via two separate controllers. The 7/32 has a 32 bit word structure and over a million bytes of core can be directly addressed. Therefore, adding more core to be able to service more users requires no software change as far as core allocation requirements.

Currently the system provides a 24 port capacity over TELENET and eight local Newark ports. The disk system is expandable by adding additional disk units. The result is a system able, through the modularity of the hardware, to be expanded to accomodate a maximum population of 1000 users.

The software is based upon round robin service doctrine, where service is given up by a user whenever an I/O (input/output operation) is executed. The "intelligent" I/O routine passes control to a scheduler which chooses the next user in turn who is not waiting for an I/O service operation to be completed. This also means that at certain places in the program virtual I/O's are used to insure that no unfair allocation of service can occur. The result is a multiuser system regulated by events rather than time slicing. We believe this is a more efficient doctrine for a system that is communications oriented as opposed to computation oriented.

This main interaction program itself is written at the FORTRAN level as if it only knows about the one terminal (or one user). All data pertinent to a user

are defined in a common block. Special routines, triggered by the I/O, literally fool the FORTRAN code by shifting from where the FORTRAN code believes the common data area to be to the area containing the new user's data. In order to implement this approach, advantage was taken on the INTERDATA FORTRAN V feature of producing assembler level output. A special "Mid-Processor" was produced that could modify the subroutine linkages and reorganize the data structure of the compiled FORTRAN program. Other work necessary involved modification to certain executive routines and I/O routines as well as the disk controller's software.

Having the interaction flow at the FORTRAN level with over 40 subroutines specialized for common types of operations ultimately allows a straightforward capability for adding or modifying user features and allowing the system to adjust to the preferences of the users.

In addition, a reentrant input and separate output editor were written at assembly level. The editors and user input/output routine represent an integral independent routine that can be off loaded to a front end processor if this should prove desirable for the larger user population that might occur in later years.

The EIES system has an internal priority structure which can be utilized when necessary to establish different classes of user service. The system allows 32 relative priorities on such functions as editing, receiving and searching. Also a different priority function forces sharing of work space or swapping to disk of lower priority users. This was specifically added to allow incorporation of a large secondary user population who would not interfere with primary NSF users resulting from the funded trial projects.

The approach to the overall software development effort has been to maximize the flexibility and anticipate what modifications may be desirable in the

future. This is in sharp contrast to building a minimal capability needing major revisions to account for any growth in service. The system will be operated in a manner which will allow users to express their wishes for additional features and to utilize this input to formulate the development over time. This input exists via the public conferences PROBLEMS and SUGGESTIONS where any member of EIES may enter his or her comments and through the evaluation follow-up questionnaires. The total completed software development effort under the grant is estimated to be six person years.

EVALUATION

Objectives

From the point of view of the evaluation effort, EIES is an interesting innovation in scientific communication which must be examined in terms of two main questions:

1. Will it actually be used? If so, how much and in what ways, by various individuals and groups? Most importantly, what factors may explain variations in amount and pattern of use?

2. If it is used extensively by a group (as is the hope of the designers of the system), what effects will this have on such factors as productivity, the degree of "paradigmatic development" of method and theory, the social structure of the research community, prevailing norms, etc.? What will be the unanticipated consequences, and how can we plan data gathering so as to "capture" them for later analysis? Or, will there be no noticeable effects of the communications medium at all, with EIES simply substituting for current forms of communication?

The purposes of the evaluation effort were to:

1. Develop and pre-test questionnaires to be used in the assessment.

3. Develop monitoring statistics and ways of utilizing them so as to be as descriptive as possible of the type and amount of activity on the system, without invading the privacy of individuals.

3. Develop procedures for automatic analysis of the questionnaire data and monitor-gathered statistics.

4. Begin to serve a "formative evaluation" function by observing and reporting the ways in which members of EIES actually use the system; what they like and do not like; and those things with which they seem to have difficulty or experience frustration. This information was gathered through direct observation in conferences, and personal interviews with some members, as well as through the questionnaires.

5. Visit with and explain the evaluation to potential principal investigators and assessors for groups which express an interest in responding to the NSF announcement to utilize the EIES system, in order to maximize the cooperation of potential user groups and their assessors.

6. Develop a program to perform citation analyses in order to assess certain long-term effects of the use of EIES by scientific specialties.

Objectives three and six were not accomplished, due to cessation of funding; considerable progress was made toward the other goals, despite lack of funding. Although the original grant provided for limited support of the above sorts of assessment activities, such support was excluded from the renewal grant and subsequent contract.* What will be reported here will be the efforts supported by D.S.I. through the end of January, 1977, supplemented by some findings from the continued evaluation efforts which proceeded without funding or with small amounts of support obtained elsewhere. The Division of Mathematical and Computer Sciences is now supporting evaluation efforts of this nature as a separate project. (MCS 77-27813, effective March 1, 1978.)

We will present a brief and necessarily selective report on the evaluation activities carried out and some of the initial findings and observations. All such "findings" are very tentative, since there was no group of scientists who used the system for a long enough period of time to warrant any firm conclusions, before funding for the evaluation ceased. What this section will do is describe the initial groups that were studied; the evaluation instruments used to collect data on them; the initial findings for these pilot groups; and some of the main methodological problems related to the assessment of the impacts of these field trials. We will then turn to the monitor-gathered statistics collected over a much longer period and to conclusions that can be drawn from them.

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*One unfortunate result is that the questionnaire data collected for the pilot period could never be coded and analyzed in detail, since this had been scheduled for the summer of 1977.

Questionnaire Development and Pretesting

The development of the questionnaires represented a continual trade off between (1) the need to include a great many variables that may affect the amount and type of use of EIES and its effects upon scientific research groups; and (2) the need to keep the length of the questionnaires within some reasonable limit so as to assure as high a response rate as possible.

Four different questionnaires were developed and pretested:

1. A pre-use questionnaire for scientific research groups.
2. A "general users" questionnaire for groups which do not fall under the above, such as NSF's group 20.
3. A first follow-up questionnaire for individuals who have made five or more hours of on-line use of the system during the approximately first three months after authorization to use the system.
4. A short follow-up questionnaire for those who have made little or no use of the system.

Initial drafts of the pre-use questionnaire for scientists were developed by Roxanne Hiltz and Ian Mitroff; several subsequent versions were evolved by Hiltz, Featheringham, and Turoff, with some consultation by Diana Crane, Barry Barnes, and Nicholas Mullins. Final revisions and pretesting of the questionnaire took place after expiration of NSF funding.

The initial draft of the pre-use questionnaire for general users was developed by Tom Featheringham; Featheringham and Hiltz subsequently worked together to produce several sections that would be exactly the same for the two versions, in order to facilitate comparative analysis.

All new users of EIES were sent a copy of the appropriate pre-use questionnaire with their starter packet. Initially, they were asked to complete the questionnaire before signing on the system the first time; subsequently, however, it was decided that this might be keeping some users off the system for several weeks. Instructions now read that the new user may choose to complete the

pre-use questionnaire before signing in the system, or may sign on first and try the system for a short while before completing the questionnaires. Besides proving less of a barrier to use of the system, this procedure should provide a more similar answering condition between those who have seen live demonstrations of EIES and those who have not.

Revisions to the pre-use questionnaire have been made in response to marginal comments; high rates of no answers for some initial questions; and direct comments made during the personal administration of some interviews or personal follow-up interviews subsequent to a respondent's completing a questionnaire.

The pre-use questionnaire now contains questions on the following items, which have been developed into structured, precoded questions in so far as possible:

Information on the user group's research specialty (age of specialty, number of years active in it, existing journals and conventions, outstanding people; degree of competitiveness).

Scientists current style of work and communication:

1. Hours/week spent in various professional activities
2. Current forms and amount of communications
3. Previous contacts with EIES user group
4. Concern about work being "stolen" by others
5. Positions on two norms of science:
    a. emotional neutrality vs. emotional commitment
    b. universalism vs. particularism

Background items:

(Age, sex, years since degree, prizes and publications, cognitive style, perceived standing in the specialty).

Communications skills and facilities:

1. Reading, writing, speaking, and typing skills
2. Attitudes toward computers
3. Previous use of computers and terminals
4. Access to terminals, at home and at work
5. Types of terminals (hard copy or CRT, etc.)

Current expectations about EIES:

1. Reaction to the information brochure
2. Anticipated amount of use
3. Incentive for using the system
4. Overall rating of probable worth of EIES
5. Probable limitations to use.

Since an unanticipated large proportion of invited members of the initial groups on the system never signed on or made very little use of the system, it was decided that a separate, short follow-up questionnaire needed to be developed for them. The follow-up questionnaire has been pretested on Groups 20, 70 and 80. Only a few revisions need to made, on the basis of responses received. Completion time for the "long" follow-up has averaged twenty minutes, which is on target. We experimented with "reminder messages" sent to those from whom follow-up questionnaires had not been received within three weeks, and these helped somewhat.

For the follow-up questionnaire (long version), the variables covered are:

A. Access and use pattern

   1. Time spent using EIES (actual vs.preferred; off-line vs. on-line; office vs. home or other).
   2. Access to computer terminals
   3. Input procedures

4. Filing procedures

B. Overall reactions to the EIES Mode of Communication

This is a series of nine seven-point scales. They may be used individually to obtain average profiles of perceived aspects of the system; clustered by factor analysis; or added together to form a subjective reaction scale whose value ranges from nine to ninety.

C. Reactions to specific features of the system

1. (A one to four scale, ranging from "Extremely valuable" to "useless", on specific features)

2. Learning pattern

3. One-to-five rating scales on other aspects of the EIES system (brochure, language, editing commands, subjective feelings during use)

4. Reactions to privacy aspects of the system and to synchronous exchanges

5. Difficulties with terminal, telenet, or anything else which has cut down use

D. The concluding section consists of four open-ended questions which ask for overall progress and positive and negative aspects of use of EIES for the group.

The follow-up questionnaire (short version), consists of a check list of possible reasons for little or no use of the system; plus several open-ended questions probing attitudes toward potential advantages and disadvantages of the use of the system by the group, and potential conference topics of interest.

Every structured question in each of the questionnaires is designed as a measure of a variable which is included in sets of hypotheses developed before the questionnaire was designed. The open-ended questions and unstructured interviews are designed to probe for unanticipated or possible negative consequences of use, which might might be further explored in subsequent structured questionnaires.

Initial User Groups

The quantified results that will be reported are based on returns of pre-use and follow-up questionnaires and monitoring statistics from the two groups which were on the system for at least three months by the end of 1976. It must be noted that none are typical of the "small research communities" for which the system was designed:

"Group 20" consists of the administrators and contractors and grantees of the Access Improvement Program of the National Science Foundation. They were requested to use the system to communicate with the NSF office.

"Group 80" was a multidisciplinary team engaged in an environmental education project for the Department of Health, Education and Welfare. The system was used by them mainly as electronic mail for project administration, rather than for substantive discussions. The project director strictly rationed allocated hours on the system.

Groups 70-73 were part of a Workshop on Computerized Conferencing sponsored by the Division of Computer Research. "Group 72," a Computerized Conferencing Workshop on Applications and Impacts of Computerized Conferencing, had generated a discussion involving approximately 25 invited participants and over one hundred conference entries by the end of February 1977.

"Group 89," was a national modeling group consisting of persons representing different approaches to the question of how and for what purpose to build large scale economic-social models. (Systems dynamics, econometric, and sociological approaches were represented by members of this group).

The Human Element: Variations in Participation*

The evaluation was primarily concerned with the "human element" in the

*For a fuller account of preliminary results of the evaluation, see Hiltz, 1977b, from which this section is derived.

use and impact of the EIES system, such as how and why individuals use (or fail to use) the system; and the carrying out of basic human roles which must form part of a successful man-machine communication system.

The basic human role in EIES is that of a "member" or participant; a person has to be motivated to sign on to the system regularly and to engage in free and fairly time-consuming exchanges, if the system is to have any noticeable impact upon group communication or productivity.

During the first three months of pilot field testing, we found that participation was very uneven and that there are definite variations by group. A large number of persons who are invited to use the system either never sign on at all; or use it one or two times and then stop. (Figure 1 shows the distribution of total number of connect hours for the first four trial groups on the system, during the first three months the system was available). All of those individuals who had spent in excess of fifty hours on-line belonged to at least two groups and were group coordinator or conference moderator for at least one group.

Rough estimates of the relative importance of various reasons for little or no use can be obtained from the initial returns from the follow-up questionnaires, based on 25 members of groups 20 and 80 who returned the "short follow-up" (sent to those who used the system a total of less than five hours). Question one was a structured question which read, "Which of the following have limited your use of the EIES system?" (Figure 2 shows the proportion who marked each answer.)

Some people do not have access to a computer terminal, so that explains their lack of participation. Others, however, just do not feel inclined to use the system, and never bother to spend the two or three hours that it takes to become an accomplished user. Among these are persons who do not know many people in their "group" or wish to communicate with them; persons who had a bad

Figure One

Variation in Distribution of Number of Hours of Connect Time by Group (for the First Three Months Trial Use of EIES, for Four Trial Groups)

Number of Hours	Number of People				
	Group 20	Group 72	Group 80	Group 89	All Four
Zero	9	2	6	1	17%
1	9	2	6	1	18%
1-4	15	7	7	4	33%
5-9	11	2	1	1	15%
10-49	4	5	4	0	13%
50+	1	4	1	0	6%

Figure Two

Reasons Given for Non-Use of EIES

% Checking	
52%	I have temporarily been tied up with other things; but intend to use it more in the future.
32%	Inconvenient access to a terminal
32%	Trouble with telephone or TELENET connection.
32%	Tried but had some bad experiences (system crashes, etc.)
24%	There is no one on this system with whom I wish to communicate a great deal.
12%	The system looked too complicated to use
12%	I really do not have the time to use a system like this.
(none)	I do not know how to type or do not like to type.
(none)	I do not like using computer systems.
Other	
	(1 person) system not available Pacific time in evenings
	(1 person) Used up allocation

Source: Follow-up questionnaires, Group 20 and 80, N=25.

Tabulation of the data was partially supported by a grant from the Division of Mathematical and Computer Research; fuller results of follow ups are included in Hiltz, 1977b.

Source: Hiltz, 1977b.

experience with the TELENET, hardware, and software failures that plagued the system during the first few months; persons who feel they are "too busy" for the particular activities going on in their group.

One variable which was not explored in the short follow-ups is the substantial psychological hurdle provided for a new user who receives a very bulky set of materials in the mail, but no human help in learning to use the system and no face-to-face contact to smooth the formation of social relationships in the user group. It is hypothesized that an interal face-to-face meeting would result in much higher participation rates. At such a meeting, the participants would learn the fundamentals of using the system, so that the written documentation would be needed only for review and further practice. Secondly, the group solidarity and consensus about the purpose of the EIES communication for the group could be strengthened. The strongest test of this explanation of missing facitilating and motivational factors will be provided in the current field trials, in which two groups are following the pilot - period pattern of receiving only written documentation andd two groups and beginning with a face-to-face meeting.

On the other hand, some members begin to use the system for an average of an hour or more a day, doing the bulk of their professional communications through this medium. When a person gets to the point where he or she begins to receive fifty or so messages or conference entries a day over the system, then a new human problem begins to be felt; that of "information overload", or how to cope with the volume of things that comes pouring in. This phenomenon needs to be studied more thoroughly in follow-up data collection procedures.

Though total time on the sytem is distributed very unevenly, participation in actual conferences tends to be much more equal. For instance, in conference 72, the distribution of the number of text lines contributed by each of the

persons who joined the discussion is shown below (for the first 109 entries, 2345 lines, through February 1977).

1-99 lines	5 persons
100-299 lines	6 persons
300-399 lines	3 persons

Two of the five "low" participants were actually in the conference for less than a month. What these figures show is that the majority of the participants made fairly substantial contributions; it seems unlikely that a face-to-face conference of fourteen persons would have resulted in such a relatively equal participation pattern.

Turning to other human roles, just as it takes a lot of work for the organizer of a session at a professional meeting to put together a group which is well balanced among different points of view and to help the session run smoothly, so too, there is need for a human organizer of a computerized conference.

In order for a computerized conference to be successful, according to initial observations, the moderator has to work very hard at both the "social host" and the "meeting chairperson" roles. As social host she/he has to issue warm invitations to people; send encouraging private messages to people complimenting them or at least commenting on their entires, suggesting what they may be uniquely qualified to contribute. As meeting chairperson, she/he must prepare an enticing sounding initial agenda; frequently summarize or clarify what has been going on, try to express emerging consensus or call for a formal vote, sense and announce when it is time to move on to a new topic. Without this kind of active moderator role, a conference is not apt to get off the ground.

It should be noted that the "chairperson" role was hampered during the pilot period by the absence of several software aids that were not available, such as titles for conference entries (which can be listed and serve as a table of contents for participants); sequencing of comments to show which are related to one another; or voting.

User Reactions to the EIES Mode of Communication: Initial Results*

Seven long follow-ups were received from members of groups 20 and 80 who were connected neither with NJIT nor with NSF, by the end of January, 1977. Of course, this is a very small number, and those who both used the system more than five hours on line and returned their questionnaires immediately upon receipt cannot be said to be representative of all EIES users. However, their reactions help to pin down the probable typical image of the system held by regular users, in terms of subjective impressions.

There were nine seven point scales; One was the highest rating; 4 was neutral; 7 was the lowest ("bad adjective") rating, except for the "frustrating" scale, which was inadvertently reversed on these initial draft questionnaires. Below are the items and the mean ratings.

Overall, the EIES communication system is

Extremely Good	...	Extremely Bad	3.0

I find using EIES to be

Stimulating	...	Boring	3.6
Productive	...	Unproductive	3.6
Great Fun	...	Unpleasant Work	3.14
Time Saving	...	Time Wasting	4.0
Frustrating	...	Not Frustrating	4.14
Friendly	...	Impersonal	3.14
Easy	...	Difficult	2.14
Not Demanding or Intrusive	...	Very	2.86

Mean Time until they had "learned to use EIES well" was 3 hours.

All but one of the ratings were on the positive side. The exception was that they found it neither time saving nor time wasting (at this point). The highest ratings were for "easy to use"; in contrast to the sizeable proportion

*For results based on 29 returns, see Hiltz 1977b.

of nonusers who thought it looked too complicated or difficult to learn.

The information brochure was in obvious need of improvement (and this was subsequently done). On a one-to-five scale, the mean ratings from these seven most experienced users were:

understandable	...	not understandable	3.14
easy to read	...	hard to read	2.86
well organized	...	not well organized	3.86

One problem pointed out by some users is that the style and organization of a training manual for new users is not optimum for a permanent reference document; perhaps two different documents are needed, for these two purposes. Indexing has also been suggested by several users.

Some Initial Observations About Variations in Acceptance and Use of EIES

Based upon the behavior of the pilot groups using the system, the following conditions seem to be necessary for heavy use to be made of EIES:

1. The members must have easy access to computer terminals, preferably at home as well as at the work location. (Seems obvious but has not been made a condition for being given membership).

2. There seems to be some minimum "critical mass" of the group, both in number of members and number of different geographic locations in which the clusters of members are located. A rough guess at this point is that the minimum may be about a dozen active participants in three or more locations.

Below this "critical mass", there are not likely to be enough new messages or conference comments entered so that there are always new items to be received and responded to. Above the minimum size and dispersion, enough activity and controversy can be generated to motivate members to sign on frequently and to actively participate in the exchanges.

Group 89 suffered from the problem of insufficient size and was the source of the "critical mass" hypothesis. It had only five participants; and three of them were co-located within one hundred feet of one another's desks.

3. There has to be a considerable investment of time and effort by several members of the group who play key roles. If the conference moderator or group leader do not sign on frequently, the use of the system by the group will atrophy.

An important factor in determining the success or impact of this system is what are the possible rewards or motivations for scientists to assume these time-consuming roles? For example, being the editor of an established journal confers prestige; however, being the editor of an EIES BULLETIN may not be seen as having very many extrinsic rewards.

4. The group must be a "real" group and must want to use the system.

By a "real" group, is meant one in which most of the members already know one another personally or professionally, and in which there is a history of shared research concerns and familiarity with and exchange of materials on one another's work. The medium, unlike the professional convention, cannot be relied upon to foster the development of acquaintances and common interests when absolutely none exist to begin with.* The members cannot be coerced or subtly pressured to agree to try the system. Though a person can begin to use the system's message and conference features after about a half hour of practice, it takes several hours to become comfortable and familiar with all of the various commands and options. A user who is not strongly motivated to communicate with the other group members to begin with will not be willing to invest this learning time.

An example of a lack of these conditions is group 20. In the pre-use questionnaire, a majority indicated that use of the system was not a free choice by them:

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*If a user is strongly motivated to communicate with members of one group and signs on frequently, it is likely that he/she will make new or additional professional contacts on the system, however.

Q: Which statement best describes your incentive for using the system?

4 = I am required to use.

4 = I have been requested to use it.

4 = I am free to use it as I wish.

After three months many of the inactive users indicated on the follow-up that they still did not know who was in their group, or what its purpose was. The following are some comments which illustrate this:

"I don't know who is a member of conference 20."

"Not sure yet (how many he knows). Perhaps two or three."

"I think that your main problem is that many of the participants have no interest in EIES. They have been recruited and have not volunteered."

"Group 20 seems to be a dumping ground without charter or purpose. I look to other groups for activity."

This latter comment also points to an interesting phenomenon. Having found group 20 to be in a state that might be termed "anomie," at least four members joined or formed other groups that were oriented to a specific purpose, and seemed quite active or enthusiastic about them.

Perhaps this is the most important conclusion which can be made at the present time; that users will utilize the system in many unanticipated and innovative ways. For example, one conference moderator decided to solve the "getting to know you" problem by starting the group's conference with a synchronous (simultaneous - on-line) Friday evening "cocktail party" ("bring your own!"). Some of these innovations will work; some will not. The evaluation project will continue to attempt to capture, document, and generalize conclusions that can be derived from such unanticipated behavior and its outcome, in terms of its implication for future design and applications of systems such as EIES.

Some Unresolved Methodological Problems*

Some problems are resolvable if a higher degree of importance were attached to systematic evaluation. These include:

1. The bulk of the communication on EIES occurs through private messages, the content of which is not available to an evaluator. About 75% of the items and 50% of the text lines sent were in messages rather then in comments. Some mechanism must be found for evaluators to have access to at least a sample of the content of these communications if they are to be able to fully describe and analyze the communications they are studying.

2. No users of the system are required to cooperate in answering questionnaires or supplying other data. The non-respondents tend to be the non-users or the infrequent users. Some sort of incentive seems necessary in order to obtain acceptable response rates from user groups.

3. Ideally, for research purposes, user groups would either serve as "their own controls" by having their communication and productivity monitored for 3-6 months before use; and/or by being matched to similar groups who do not use the system.

4. Incomplete system -- Some of the potentially most valuable communication aids are not available on the current EIES system. This includes graphics and a fully operational "HAL" to interface other computer resources.

Other methodological problems and limitations seem to be intrinsic to a limited-scale field trial. It is recognized that this field experiment will distort and fail to measure what might actually occur should computerized conferencing become a "normal" widespread, non-experimental mode of communication.

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*Several of the ideas in this section benefited from a discussion with Joseph Martino of the University of Dayton Research Institute.

Among this class of problems are:

1) The Technology Is New and Will Be Limited to a Single Group.

One analogy which might be made is to the situation when telephones were new and owned by only a few persons. Just as one used to have to shout to be heard over long distance and was subjected to much static, so it can be expected that there may be a few technological kinks in the system in the beginning, which may discourage and frustrate users.

Secondly, the scientist-users will have to resort to other communication modes for other roles they play and their associated communications. Eventually, terminals in the home and the use of computerized conferencing might become as cheap and widespread as T.V. ownership is presently. At that point, one could belong to many "conferences", corresponding to all of one's roles: a "family news" conference, for example, and a chess conference. For the duration of this field experiment however, only the approximately 300 scientists on the system will be able to be reached by computerized conferencing.

As a result, use of the system will have to be added on to use of other communications modes rather than replacing much of their use. A related factor is that for system planning purposes, the specialty group's ability to expand to include new members on the system has been arbitrarily limited during the course of the experiment. If computerized conferencing were a generally available service like the telephone, any number of additional persons might join the network. Still another factor related to the newness and scarcity of the technology is that many of the scientists might never before have used a computer terminal and might not have any other use for it; thus, the learning might be somewhat annoying. Furthermore, since the user will not generally have a terminal both at home and in the office, he/she must take the trouble to carry it around if it is to be available at all times. If the day ever comes when

terminals are as omnipresent as T.V.'s, they will always be conveniently at hand without foreplanning, and used with as much frequency and ease as more familiar household appliances are now.

2) The Hawthorne Effect

The scientists in this study will know that they are being observed. They will also know from the questionnaires they answer and from announcements of the project what variables are being watched. This cannot help but affect the behavior of the persons involved. They may tend to be self-conscious about what is entered into the system, knowing that "big brother" evaluator may be out there somewhere reading the transcript. They may deliberately distort their questionnaire.

3) Long Term Effects

In the current experiment, scientific communities are given approximately a year of access to EIES. However, the development of a new scientific concept or the transition from hypothesis to proven "fact" may stretch over time frames of a decade or more. In addition, the knowledge that access to this new communication medium is only temporary may decrease the motivation of scientists to learn to use the full capabilities offered or to become dependent upon it.* Thus, it will be difficult to determine the extent to which one single year's use would produce the same kinds of impact upon the work of a scientific community as would a permanent system whose future availability for the completion of long term projects could be counted upon.

4) Geographic Limitation

The most important potential effects of computer based communication systems may be the facilitation of international communication. The present experiment is limited to North America, however.

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*Several members of current EIES groups have explicitly stated to the evaluator that this is the case.

V. EIES USAGE DURING THE DEVELOPMENT PERIOD

A. BACKGROUND & ACCOMPLISHMENTS

During the period of 10/76 to 10/77 the EIES system underwent pilot use by approximately 200 individuals. Except for those involved directly in the EIES development effort, all the users were invited to use the system and were under no compulsion to do so. They do not represent, therefore, a population seeking to utilize this form of communication, as is now occuring under the NSF announcement inviting proposals for the use of EIES. However, the statistics that are examined in this section do provide certain items of useful information for understanding the behavior of users on this system and for evaluating some aspects of costs and benefits. This report utilizes the monthly statistical reports generated during the trial period to look at basic considerations of throughput and usage patterns as a function of user experience.

We will begin with the basic statistics collected by the monitor routine on gross traffic through the system -- total number of users, time on, items sent and received, etc. We will then refine and interpret these statistics in order to make inferences about user behavior patterns and to derive measures of cost and benefit that will be necessary in order to compare this medium of communications to alternative media. The basic strategy in the second part of the analysis is to extract a User Sample which excludes programmers and others whose behavior distorts the data in terms of its representativeness of actual users. The next step is to divide this user sample into classes based upon total amount of use, so that we can determine changes that occur as experience is gained on the system.

Utilizing the data derived on such factors as average time invested per item received and words per minute input rate, we will then attempt to make a comparative analysis of the costs of sending information to a group using EIES vs. alternative media. Contrasts between observed behavior on EIES and that

on other computer-mediated communication systems will be included in the section on comparative analysis. Finally, we will summarize the observations and interpretations we have made using the EIES statistics, as a set of hypotheses. We hope in the future to be able to have fuller and more comparable data on the various communication modes covered, in order to be able to test these hypotheses, which were derived by induction from the data presented here.

Before embarking on this exercise or presenting the measured and derived statistics on user behavior, however, we would like to summarize the kinds of changes which took place during the development period, largely as a result of feedback from these pilot users. In other words, the main benefits derived during this period, from the point of view of the development effort, were the many changes made in the system as a direct result of user experience. Among these are:

Enhanced Text Editing
The desire of users to dress up items of a more permanent nature led to major extensions in text editing and refinement of existing features. The incorporation of these features may be related to the fact that EIES text items have a significantly larger size than is typical of either other message systems or conference systems not having well integrated and powerful text editing features.

Message Control
The design philosophy for the handling of messages underwent considerable change as it was realized that users seemed to have a need for a number of months to refer back to or obtain messages that had been previously delivered. EIES now maintains a centralized common file of the last 30,000 messages, which is always available for retrieval by senders or recipients of a messsage. This approach is considerably different than that of other systems, such as the ARPANET message service, and leads to a very different psychology on the part of the user for the handling and use of messages.

Text Manipulation
EIES now incorporates a completely lateral ability to transfer, copy, merge and generally manipulate text items which cuts across the standard division of messages, comments and pages. As a result, the experienced user has the facility to deal with common subject matter he or she has written or received, regardless of how it was initially originated in the system. The current ability to do this is considerably more flexible than what was conceived in the original design specifications. To a large extent this is due to the feedback of users.

Convenience Features

A number of special features resulted from both direct suggestions of users and indirect evaluation of user problems. Typical of this was the "information overload" problem users found upon receiving large amounts of new material at any session on the system. As a result each EIES user now has available his or her own private file of one line reminders that can be used to log and reference items received on the system which the user wants to delay responding to until a more convenient or appropriate moment.

Terminal and Formatting Control

Experience with a wide range of differing terminals led to much sharper distinctions between formatting control of text items by receivers and writers and the ironing out of consistency and priority relations between these. There is now a fairly flexible ability of a receiver to control the form of his output independent of the writer's compositional choices.

Statistics

As a result of experience, refinement has taken place in the statistics that are now gathered on EIES use. Because of the richness of EIES one could consume the resources of the computer in merely measuring what is taking place. As a result it becomes necessary to have some balance between hypotheses or models of what is taking place and an understanding of what statistics would be of use in establishing the validity of the hypotheses. We do believe the collection of statistics in the EIES system has to be an evolutionary process.

Advanced Features

A small but significant number of EIES users did evolve to the point where they have been tailoring and designing their own interfaces and methods of interaction with the system. This has been a result of a decision made during the development phase to incorporate the availability of a programing language within EIES text. EIES now allows a considerable range of modifications the user can make from a simple way to tailor his or her own commands to full scale programs capable of gathering information in an organized manner from other users--questionnaire and form design. Some of this resulted from considerations of what would be desirable for those conducting research or evaluations on EIES. Another potential use is soliciting material from a group of people engaged in specific secondary scientific support objectives, such as standards setting.

User Consultants

The trial period led to the establishment of individuals independent of the EIES development group who act as educators or on-line consultants for those users having difficulty following the written documentation or seeking to learn advanced features. User consultants on EIES are volunteers drawn from active EIES users who receive no pay for this activity but do receive free time for use of the system. It is assumed, and appears to be borne out by other types of interactive systems, that users may feel freer about discussing problems with the user consultants than directly with those involved in the EIES effort. A file is kept of problems brought to user consultants that has been a very useful form of feedback. Also, the user consultants appear to aid in building up a community or group feeling among users for the exchange of information on new ways to do things or developing norms on styles of communication and writing.

Feedback Refinement

It has become quite evident that evolution of the design of such systems must function as a result of a balanced feedback program which is likely to involve systematic questioning of users, observation of user behavior both statistically and in terms of participant observation, and indirect feedback via individuals acting as intermediaries. As the current statistics bear out, behavior on this type of communication-information system is not typical of either data base or other time sharing type systems. Since systems of this sort represent a completely new psychological and sociological environment for most users, the connection or relationship between user perceptions and design option decisions is not, in many cases, a clear or direct one. In fact, it appears desirable to involve those users who desire it directly in the process of design itself. We have, in fact, done this with a small number of users. While this has led, we believe, to a much better system, it does prove to be a more labor intensive effort with respect to the evolution of the system and a more demanding one with respect to the talents that must be present within the total feedback operations. The EIES effort has not only involved user participation in the design process but has incorporated inputs specifically from psychology and sociology into design decisions. We also believe this is a necessity for computerized conferencing systems and that these systems are breaking new ground with respect to user behavior. It also appears to us to be impossible to separate the technical design issues from these considerations or to completely standardize or freeze the design while the user behavior aspects undergo significant changes.

Educational Materials

As a result of user experience and user contributions, the educational material has undergone considerable evolution. Since most users of EIES will not have individual instruction and must rely on the written materials supplied, this is very significant to the long term success of the effort. The current user manual (Appendix) received considerable input from users and the primary authorship is by the EIES designer and two users. Interestingly these parties have never met face-to-face and are only acquainted through EIES itself.

B. BASIC STATISTICS

The interpretation of the following statistics cannot be divorced from the material gathered from questionnaires and interviews, as well as other feedback and observation. Some of the observations we will make about what the data mean are a result of the merger of these diverse sources.

The first five tables represent measured statistics obtained on a monthly basis. A user is a single individual, who in a few cases may have had more than one membership number when his or her reason for participation on the system changed. In such cases addition of statistics for the two memberships was done

to create one user. Special roles such as System Monitor, Operations Manager and Center Director were not included as users or added to an individual's participation. Some users represented more than one person, using the same ID, as per the example of a husband-wife professional team or a professor and one of his students. We have no way of breaking down these statistics and they were treated as single users even when we knew this had been taking place.

Tables one and two represent distributions of number of users. Approximately 17% of the 230 individuals invited to access the system never tried the system. We believe the reasons for this are brought out in the user feedback discussed in the evaluation section and are strongly tied to not having a pertinent topic of interest and a group present on the system that they wished to communicate with, as well as to the lack of convenient access to a terminal.

Another 28% never got past the learning stage of four hours of usage or less. While some of this is no doubt a result of some of the bad experiences with some of the system difficulties early in the operations, both with EIES and with TELENET, we feel that motivational factors brought out from the questionaires are the more dominant reasons. The detailed data on users in this category, illustrated in Table 14, points out that many of them in fact did enter the system over a considerable span of months and could not have had difficulties every time. The detailed data show a very low comparative rate of sending any messages or composing anything for this class of users. While most low usage users did demonstrate that they could send a message or even write a comment, they seemed to have little motivation to do so compared to users who exhibited greater usage. This appears to confirm the view that the subject matter and the individuals available to communicate with are key to the motivation of an individual user. It would be our hypothesis that the groups motivated to respond to the NSF announcement will exhibit better distributions with respect to usage.

We also believe that the lack of user consultants and of an experienced body of users during the early months may have been a contributing factor to the low level of involvement of new users who did not enter the system with a specific purpose in mind. We feel that an experienced user community willing to exchange information may be crucial to the success of the operation. This relates to the effect of critical mass mentioned elsewhere, and to the lack of sufficient public material on the system in the initial months to give new users a variety of options. The existence of a user community and publicly available material also aids in overcoming the secondary learning phase, once the mechanics of the operation are understood. This phase involves an understanding of how to best use messages and comments and what sorts of writing styles are useful in what circumstances. We have observed specific norms and rituals to emerge over time on the system with respect to these items and some are summarized in the new user manual (Appendix). In particular we observe among experienced users many unique writing style features not common to letters or other forms of written communications.

The summer months of 1977 represented a gradual cutback of users who had access to the system and a period of major revisions to the features of the design, as is evident in Table two. Table three represents hours of actual usage. Our average usage on a gross basis was about 100 users who consumed about 10,000 hours over the year, or around 100 total hours per user. This is about one-sixth the current capacity of a 300 active user population. While this exhibits a planning figure of two hours per week per user a more detailed analysis in the later tables by usage categories shows that very active users exhibit more like 6 hours per week on the average. Currently, our best estimate for planning purposes is a range of 3 to 4 hours per week. We suspect the makeup of users under the announcement will shift our current two hour average

toward this range, because a much smaller percentage of them will turn out to be inactive users and a larger percentage should turn out to be active users, than was the case during this test period.

Table 1

USAGE DISTRIBUTION: Number of Individuals
by Category of Use & Total Time

/Category Hours of Use	200 Series	700 Series	800 Series	900 Series	EIES Effort	TOTAL
Never Used	23	8	7	2	0	40
1 hour or less	9	4	11	8	0	32
1 to 2 hours	5	4	2	2	0	13
2 to 4 hours	8	5	3	5	0	21
Subtotal: Learning Stage	22	15	16	15	0	66
4 to 8 hours	11	4	5	5	0	25
8 to 16 hours	7	7	9	8	8	39
Subtotal: Casual Use	18	11	14	13	8	64
16 to 32 hours	2	5	0	6	2	15
32 to 64	4	5	2	7	2	20
64 to 128	2	1	1	1	5	10
128 to 256	0	1	0	1	2	4
256 to 512	0	0	0	0	5	5
512 to 1024	0	0	0	0	6	6
Subtotal: Active Users	8	12	3	15	22	60
TOTAL	71	44	40	45	30	230

Table 1 represents a distribution of hours of usage from 10/76 until and including 10/77. Of the 230 individuals who were invited to have access to the system, 40 never made an attempt to get on the system. The 200 series of users represents, in large part, the Principal Investigators for Grants and Contracts of the Access Improvement Program of the Division of Science Information of NSF. The 700 series represents a special workshop project for the Division of Computer and Mathematical Science of NSF on future research directions in the area of human communication via computers. However, it should be noted that members of EIES in the 200, 800 and 900 series also participated in this workshop. Therefore, members of the 700 series represent only those invited in for this specific

task. The 800 series represented three test groups that were provided access as experiments. One involved project management on an HEW research effort that NJIT was involved in; one was a small group in Systems Dynamics and the other was a small group coordinating activities for a major professional meeting. The 900 series represented internal experimental use of the system made by NJIT students and faculty and represented such applications as coordination of related research in human communication via computers, graduate class discussions, controlled experimentation and coordination of the student ACM club activities. The EIES support represents both those involved in development and direct service to the users of EIES.

Table 2
NUMBER OF USERS
by
Month and Category

/Category Hours of Use	200 Series	700 Series	800 Series	900 Series	EIES Effort	TOTAL
Month						
10/76-1/77	40	21	29	14	19	123
2/77	32	20	18	30	21	121
3/77	32	23	17	31	22	125
4/77	29	26	19	31	24	129
5/77	22	24	16	19	25	106
6/77	25	21	15	19	27	107
7/77	24	19	9	15	27	94
8/77	10	16	5	13	27	71
9/77	12	13	3	7	27	62
10/77	11	11	1	7	24	54

Because the period from 10/76-1/77 represents a transitional one from no users we are lumping that period as one data entry on the monthly breakdowns in the above and succeeding tables.

Table 3
NUMBER OF TIMES ON and HOURS OF USE
Accumulated and Monthly

Month	TIMES LOGGED ON Accumulated	Monthly	HOURS OF USE Accumulated	Monthly
10/76-1/77	7,849	X	2,241	X
2/77	11,404	3,555	3,413	1,172
3/77	14,126	2,722	4,325	912
4/77	16,788	2,662	5,220	895
5/77	19,037	2,249	5,981	761
6/77	21,997	2,960	7,180	1,199
7/77	23,935	1.938	7,910	730
8/77	25,920	1,985	8,645	735
9/77	26,948	1,028	9,027	382
10/77	28,497	1,549	9,837	810

It should be noted that by the summer of 1977 the formal efforts on the system such as the NSF workshop were largely completed and only those users who had come to use the system on a regular basis for professional communication continued active. In September of 1977 the system was shut down for a significant period to allow change over to a new interface design. Much of the effort in October was concerned with debugging that interface and documenting new user materials.

Table 4
MESSAGE TRAFFIC
Number of Messages Sent and Received
Accumulated and Monthly

Month	NUMBER SENT Accumulated	Monthly	NUMBER RECEIVED Accumulated	Monthly
10/76-1/77	7,585	X	16,702	X
2/77	11,160	3,575	26,238	9,536
3/77	14,439	3,279	30,566	4,328
4/77	17,480	3,041	37,988	7,422
5/77	20,454	2,974	44,256	6,268
6/77	24,378	3,924	51,973	7,717
7/77	27,233	2,855	57,461	5,488
8/77	29,904	2,671	63,016	5,555
9/77	31,123	1,219	65,655	2,639
10/77	34,301	3,178	76,628	6,973

Table 5
CONFERENCES AND COMMENTS
Number of Comments Composed and Read
Accumulated and Monthly

Monthly	NUMBER OF CONFERENCES	COMPOSED Accumulated	Monthly	READ Accumulated	Monthly
10/76-1/77	26	727	X	9,546	X
2/77	35	1,267	540	16,061	6,515
3/77	39	1,604	337	29,768	13,707
4/77	43	2,057	453	36,017	6,249
5/77	52	2,539	482	38,568	2,551
6/77	72	4,218	1,679	39,340	772
7/77	85	4,798	580	41,432	2,092
8/77	87	5,486	688	46,543	5,111
9/77	87	5,691	205	48,604	2,061
10/77	87	6,251	560	50,491	1,887

In June a large number of conferences were opened for use as personal notebooks. Also, a number of people were engaged in writing up what had occured in some of the activities during the prior six months. This we believe accounts for the fact that in June we observe many more comments written than read. It should also be noted that the life of a comment can be much longer than that of a messsage, in particular since it is common practice on EIES to introduce people to an ongoing discussion, in which case they will go back and read the conference transcript, often involving comments many months old. For this reason the monthly data are not particularly meaningful with respect to comparing the monthly number of items composed to those read, since a particular comment may be read much later by a newcomer to the conference. In fact, it is quite common for people to enter a conference that has been taking place for some time and to then catch up by reading the transcript that may reflect many months of discussion. The monthly data, however, do reflect the reading peak in March for the workshop conferences and the report writing peak in June for both the workshop and some other activities taking place at that time.

C. AVERAGES

Tables six through 8 represent a number of gross averages which will be refined later from the user sample. The concept we believe to be of particular concern for evaluating this form of communication is the investment in time a user makes per item received (table 6). This is a significant variable for comparison to other forms of communication and useful for looking at concepts such as "Exchange Theory" as a model for understanding the process. The time investment includes the composition time, as it is the total time of interaction divided by the items received. The figure of around five minutes given in Table 6 on a gross basis is misleading as we shall see from the sample data of Table 14. However, as we will also see, even this figure of five minutes is less than the equivalent investment in time that must be made using a phone to communicate the same amount of words. In that case there is a six minute investment. Table seven does exhibit a consistency for the average number of receivers per private message on an accumulated or monthly basis, which is slightly more than two.

The steady growth of items per conference in Table 8 is a reflection that certain conferences have exhibited a long term staying power. If we exclude those set up to accomplish a specific objective within a certain period, such as the group conferences for the Workshop, then we find the remainder fall into two categories. One, being a set of conferences that were set up but never really got going, usually because of the lack of someone willing to invest the time to act as facilitator; and, two, a set of informal conferences usually generated by a group that got together over EIES and seemed to feel they had topics they mutually wanted to discuss. These latter seem to continue on as long as the group is around and activity comes in peaks and valleys. A particular comment on a specific topic will often trigger a flurry of interaction which will slowly die out after a week or two. Then at some point a new topic or derivative of an

older one will rekindle the discussion. These conferences have no single moderator and tend to serve as both an exchange of views forum and a sounding board for concepts. Many of them exhibit a high degree of mutual trust among the participants in that people seem willing to take very far out positions; although, one wonders at times if this is not done as a stimulant to discussion rather than an exhibition of commitment to the ideas expressed. It is also common to see pennames used in some of these discussions.

Now that key words and associations are available it should be easier in the future to pin down patterns of discussion in the conferences. Conferences used as notebooks have led to a significant amount of paper writing with contributions and reviews offered by others. A number of joint authorship items have resulted, including the new users manual, the workshop reports involving eight principal authors, and some group proposal writing. In all the group writing efforts there was considerable geographical spread among those involved. The user sample data provides further insight into the tradeoff of the use of messages and conferences.

Table 6
INTERACTION AVERAGES

Month	Interaction Time (minutes) Accumulated	Interactions per User Monthly	Monthly	Hours per User Monthly	Time per Item Received Monthly
10/76-1/77	17.1	X	16	4.6	5.12
2/77	18.0	19.8	29	9.7	4.84
3/77	18.4	20.1	22	7.3	4.31
4/77	18.7	20.2	21	7.0	4.23
5/77	18.9	20.3	21	7.2	4.33
6/77	19.6	24.3	28	11.2	4.72
7/77	19.8	22.6	21	7.8	4.80
8/77	20.0	22.2	30	10.4	4.74
9/77	20.1	22.3	17	6.2	4.74
10/77	20.7	31.4	29	15.0	4.79

The first two columns of Table 6 represent the total time on an accumulated or monthly basis divided by the number of sign ons. Since the final month was largely EIES support people and the very active users the monthly figure of 31.4 minutes is very indicative of heavy users of this type of system. The next two columns are defined by taking the number of users who were active in a given month to get an average of the number of sign ons and the number of hours of use. As we will see later, these averages are very gross when one looks at a finer breakdown by users with respect to their activity as casual or active users of the system. The final column represents the total number of items received divided into the total time. This, therefore, is the commitment in time by one individual per item received; however, it does include composition. For example, if one were to compare this to a three minute telephone call one would have to say the three minute telephone call represents an investment of six person minutes of time because there are two parties involved during the three minutes. That six minutes of person time is comparable to the 4.79 minutes of EIES time per item.

Table 7
MESSAGE AVERAGES

Month	Number of Receivers Accumulated	Number of Receivers Monthly	Number Sent per User	Number Received per User
10/76-1/77	2.2	X	15	34
2/77	2.4	2.7	30	79
3/77	2.1	1.3	26	35
4/77	2.2	2.4	24	58
5/77	2.2	2.1	28	59
6/77	2.1	2.0	37	72
7/77	2.1	1.9	30	58
8/77	2.1	2.1	38	78
9/77	2.1	2.2	20	43
10/77	2.1	2.2	59	129

The first two columns of Table 7 are based upon dividing the total number of messages received by the number sent on either an accumulated or monthly basis. Because messages sent in one month can be received in another the accumulated is considered a more reliable average. The final two columns are defined by dividing the number of messages sent and received by the number of active users in that month.

Table 8
CONFERENCE AVERAGES

Month	Conferees per Conference Accumulated	Monthly	Comments per Conference	Composed Comments per User Monthly	Received Comments per User Monthly
10/76-1/77	13	X	28	1	19
2/77	13	12	36	5	54
3/77	19	41	41	3	110
4/77	18	14	48	4	48
5/77	15	5	49	5	24
6/77	9	.5	59	16	7
7/77	9	4	56	6	22
8/77	8	7	63	10	72
9/77	9	10	65	3	33
10/77	8	3	72	10	35

Column one of table 8 is the average size of a conference and reflects from June on the growing use of conferences as personal notebooks. The monthly peak in March represents the peak activity in the NSF workshop. The number of comments per conference on the average reflects a steady growth. There were a sizable number of conferences opened up that never got used by those that requested it and a sizable number that went to over 400 comments so that there is a high variance for this average. As we shall see the averages of comments composed and received per user will be better explained when we exhibit it by type of user.

D. TEXT LINES & ITEM SIZE

Table nine summarizes a dianostic of the EIES file to determine item sizes. A conference comment on EIES averages 296 words as compared to 173 words for a message. The upper limit on a text item in EIES is 684 words. While comments represent about a quarter of the items written they are over half of those received, as evidenced in Tables 10 and 11. Also text items, whether messages or comments, are noticably larger than the 150 words or less that seems to be typical of other systems offering either messaging or conferencing. Since other systems such as IFF's Planet have seen subsidized use, we do not feel cost is a major factor (although most Planet users did pay for costs). We tend to believe that the richness of the design in terms of the editing and later possible use of the items over again or for new purposes contributes to the size. There is also the possibility that the fact that the active user population on EIES has a far greater percentage of social scientists than has occurred on the other systems and that they tend to emphasize descriptive material to a greater degree than the physical scientists and engineers, may be related to larger mean item size. The issue of what influences size is still an open one. We do think that the relative size difference between messages and comments is a product of the design of the system, to a major degree. It is our impression from observation that more care and think time goes into comments and that they are viewed as a little presentation to the group comprising the particular conference. Since reward or reinforcement is gotten in a conference by members commenting back on what you have said, there is the psychological pressure to be relevant to the discussion. People have more of a tendency to actually say they agree or disagree or that a comment was interesting. This has been hypothesized as a tendency to make up for the lack of smiles, eye contact and other non verbal language lacking in this environment. Messages tend to be of a more

directed and specific nature, or of a totally socializing nature. The analysis of the data from the user sample further confirms that messages and conferences are utilized very differently and play very different but complementary roles in the overall communication process that EIES attempts to provide.

Table twelve provides an evaluation of the effective human input rate in words per second, which as a gross average turns out to be 15 words per minute or about equivalent to hand writing speed. For a number of reasons given with Table twelve this is a lower limit on the actual speed and the user sample data averages about 20 words/minute for experienced users. These rates include the interaction time of the user making choices, imputing commands, etc. We believe this overall input rate is an important measure for relative comparison of keyboard oriented systems; however, it has not as a rule been reported upon in the literature. The difference between the real typing rate for the users and the effective rate can be accounted for in two components. One is the time lost to the interaction and the other is the think time about what it is they are writing. In some of our controlled experimental work on EIES, where users were observed through one way mirrors, there was a considerable amount of re-reading of items before finalizing responses. With the tendency to larger items we would also expect more use of think time. We believe this is beneficial to the quality of the material that may be produced in systems of this sort and should not be discouraged either by the design or by the charging policies used.

Table 9
TEXT LINES
File Sample
December 1977

ITEM TYPE	Number of Items	Text Lines	Lines per Item	Blocks 512 Chrs.	Characters per line
MESSAGES	15,012	216,049	14.4	26,580	63
COMMENTS (30 Group Conferences)	1,317	35,150	26.7	4,022	59
COMMENTS (55 Private Conferences)	1,656	38,469	23.2	4,314	58
COMMENTS (13 Public Conferences)	284	6,806	24.0	639	48
PAGES (25 Private Notebooks)	318	8,054	25.3	827	53

A sample of all existing items in the File was run in December to determine the size of item types. Over eighty percent of the sample represents items written during the trial period. The average size of a message was 14.4 lines of text and the average size of a comment was 24.7 lines. We adapt these averages for use in the calculations to follow, along with an average line size of 60 characters. The slight difference in line size between messages and comments is probably due to the tendency for users to do more outlining or structuring of material in comments than in messages. The significant difference in item size, we believe, is indicative of the differences in use of messages and comments and how they are perceived by the user. The data show about 173 words per message and 296 per comment. We also note that this is considerably higher than the results reported on other systems, such as the Institute for the Future's Planet, and may be a result of having more options for both the types of communication possible as well as the more flexible text editing capability. The average size of items, taking messages and comments together, is 221 words. The limit size

on an item in EIES is 57 lines or 684 words. Looking at the same sample data broken down by month in which the items were written, average message size ranges on a monthly basis between extremes of 12.2 and 15.7 lines; whereas, average comment sizes range between 19.4 and 41 lines. There was no observed trend on the monthly basis, and the fluctuations may be reflective of certain activities being more dominant at certain times during the test period. Direct observation seems to indicate certain individuals have definite trends toward shorter or longer items. However, the distinction between message and conference size is not an individually based difference.

Table 10
TEXT LINES COMPOSED

Month	Accumulated	Monthly	Proportion Comments
10/76-1/77	126,817	X	.14
2/77	191,365	64,548	.16
3/77	246,737	55,372	.16
4/77	301,491	54,757	.17
5/77	355,980	54,489	.17
6/77	453,118	97,135	.23
7/77	508,266	55,147	.23
8/77	563,378	55,112	.24
9/77	585,893	22,515	.24
10/77	654,208	59,315	.23

Table 11
TEXT LINES RECEIVED

Month	Accumulated	Monthly	Proportion Comments
10/76-1/77	471,521	X	.49
2/77	766,503	294,982	.51
3/77	1,160,535	394,032	.62
4/77	1,418,638	258,103	.61
5/77	1,570,631	151,993	.59
6/77	1,700,439	129,808	.56
7/77	1,830,092	129,653	.55
8/77	2,033,770	203,678	.62
9/77	2,121,648	87,878	.55
10/77	2,267,725	146,077	.54

Using the averages obtained from the data in Table 9 and the number of messages and comments composed and received from the earlier tables, Tables 10 and 11 provide the estimated number of text lines that have passed through the system during the trial period. The proportions are based upon the accumulated totals. We note that while the text lines composed for comments represent only 23% of the total composed lines, they represent over 50% of the received lines.

Table 12
OUTPUT AND INPUT TIME
and
EFFECTIVE INPUT RATE

Month	Time for Output (hours) Accumulated	Monthly	Time for Input (hours) Accumulated	Monthly	Effect Input Rate (wds/min) Accumulated	Monthly
10/76-1/77	262	X	1,979	X	12.8	X
2/77	426	164	2,987	1,008	12.8	12.8
3/77	645	219	3,680	693	13.4	16.0
4/77	788	143	4,432	752	13.6	14.6
5/77	873	85	5,108	676	13.9	14.6
6/77	945	72	6,235	1,127	14.5	17.2
7/77	1,017	72	6,893	658	14.7	16.8
8/77	1,130	113	7,515	622	15.0	17.7
9/77	1,179	49	7,848	322	14.9	13.5
10/77	1,260	81	8,577	729	15.0	16.3

Table 12 assumes an output rate of 30 characters per second (6 words/minute) and uses the text lines received from table 11 to estimate the number of hours needed to deliver that output on both an accumulated and monthly basis. Using the figures on hours of use from Table 3 it is now possible to estimate how many hours were then available for input and interaction with the system. Using those hours and the text lines composed (12 words/line assumed) it is then possible to estimate the effective input rate of words/minute typed into the system. On the one hand this includes the interaction (e.g. use of commands, menu choices, etc), which would tend to make it less than the true average typing rate for a typical user; on the other hand, it would also include the use of the Copy functions for copying, editing and resending or transfering items, which would tend to make it higher than normal. However, it is only a small proportion of the user population that has yet made use of these advanced features and the effect will be demonstrated in the data that follows. Since through a good part of the operation we were experiencing delays through TELENET that produced output at considerably less than the theoretical 30 characters per

second, the Effective Input Rates are felt to be reasonable lower bounds for this period of the operation. It should also be noted that the input of 15 words per minute, representative of the total material put into the system, is a rate equivalent to handwriting.

E. USER SAMPLE

Table thirteen breaks down a sample of 129 users by categories of total usage, with each category being essentially double the total time usage of the previous one. Within each category the average values of the measured parameters are shown for those users that fall in that category. In a sense this also provides some insight into the stages of user development as a user achieves a particular level of experience with EIES. As will be shown in Table fourteen, there does seem to be a distinctive change in behavior patterns as users move to higher levels of usage.

Table 13
USER PROFILES:
AVERAGES BY USAGE CLASS

SAMPLE (129 Users)

USAGE CLASS (hours)	Number of Users	Usage (hours)	Times on	Months ACTIVE	COMMENTS Received	Sent	MESSAGES Received	Sent
1-2	8	1.3	7	2.9	21	.25	29	2.25
2-4	17	2.6	17	3.5	23	.41	42	4.7
4-8	22	6.0	37	3.4	54	.86	51	13
8-16	31	11.0	57	6.6	114	4	110	25
16-32	15	23.6	96	6.9	278	15	280	62
32-64	19	45	149	7.8	513	61	347	131
64 & over	17	231	693	9.2	1,475	254	2,370	1,408
	129							

The above sample is defined by eliminating EIES programmers, special service roles such as system monitor, and users who only had access to the system for a very short period (two months or less). The remaining 129 users were then grouped by the above categories involving the hours of total use they made of the system and averages taken of the parameters defined in the table within each

usage category. While users may have had access to use the system over three months or more, the average month of usage in the above table reflects the number of months in which they were actually active. The above data are utilized in Table 14 to develop comparative parameters which may be utilized to compare on a relative base the behavior across the usage categories.

Table 14
COMPARATIVE PARAMETERS
FOR PROFILES
Averages

/USAGE CLASS COMPARATIVE PARAMETERS	1-2	2-4	4-8	8-16	16-32	32-64	64 & Up
INTERACTION TIME (Minutes)	11	9	10	12	15	18	20
INTERACTIONS/ WEEK	.6	1.1	2.5	2.0	3.2	4.4	17.4
HOURS ON/ WEEK	.11	.17	.42	.40	.80	1.32	5.80
COMMENTS Received/Sent	84	56	63	28.5	18.5	8.4	5.8
MESSSAGES Received/Sent	12.9	8.9	3.9	4.4	4.5	2.6	1.7
ITEMS Received/Sent	20.0	12.7	7.6	7.7	7.2	4.5	2.3
ITEMS RECEIVED per Interaction	7.1	3.8	2.8	3.9	5.8	5.8	5.5
ITEMS SENT per Interaction	.36	.30	.37	.51	.80	1.30	2.40
PROPORTION of ITEMS RECEIVED which are MESSAGES							
by Items	.58	.65	.49	.49	.50	.40	.62
by Lines	.45	.52	.35	.36	.37	.28	.48
PROPORTION of ITEMS SENT which are MESSAGES:							
by Items	.9	.92	.94	.86	.81	.68	.85
by Lines	.84	.87	.90	.78	.70	.56	.76

Table 14 (cont.)
COMPARATIVE PARAMETERS
FOR PROFILES
Averages

EFFECTIVE INPUT RATE (words/minute)	6.4	8.0	8.6	10.7	14.4	19.3	27.7
ITEMS SENT/ MONTH	.8	1.3	3.9	4.3	11.3	24.7	182.0
ITEMS RECEIVED/ MONTH	18.6	18.2	30.3	33.8	80.6	110.5	416.0
TIME INVESTED/ ITEM RECEIVED (Minutes)	1.6	2.4	3.4	2.9	2.5	3.1	3.6
% UTILIZATION BY USAGE TIME							
For Sample	.2	.8	2.3	6.0	6.3	15.1	69.3
For EIES total	.1	.5	1.3	3.5	3.6	8.7	40.0

The sample represented in Table 14 is approximately 58% of the usage of EIES over the period. An additional 28% of the usage is accounted for by six programming members of the development group and the System Monitor. EIES allows programming of certain features of the system by the direct development of those items as text items in EIES. Therefore the behavior of the programming group when on line to EIES involves program composition, testing and debuging. The average interaction time of the programming group is 62 minutes as opposed to the range of 9 to 20 minutes for users. Also the investment in time per item received is 6.5 minutes or approximately double of other EIES users. Their ratio of items received to sent is 4.1 and somewhat typical of the user results, so in terms of communication use of EIES they do act like other users. Their large proportion of use of the total system during this test period does throw off the gross statistics significantly because of their programming activities while on the system. Therefore, for planning purposes the analysis of the sample data is more meaningful. Of the 14% of usage unaccounted for, approximately 9% is in other special roles dealing with administrative and user aid functions, and the remaining 5% represents short term users and some experiments and demo type applications.

First we note that the average INTERACTION TIME per session on the system hovers at about 10 minutes until users accumulate more than 8 hours and that it then rises smoothly to 20 minutes for the most active users. However, recall that each user category is approximately double the investment of total usage time of the previous one. In terms of INTERACTIONS/WEEK and the HOURS/WEEK, the two categories in the 1 to 4 hour range are very similiar, as are the two categories in the 4 to 16 hour range. After that there is a significant increase for each of the remaining categories. Four hours is the order of magnitude of the mechanics of learning the system during the test period. We suspect that

somewhere around sixteen hours (10 to 20 hour range) is another threshold having to do with learning how to employ the system to its best advantage and learning the associated norms that have been built up.

The ratio of conference COMMENTS RECEIVED/SENT shows a steady decline from 84 for the lowest usage category to 5.8 for the highest usage category. The ratio of all ITEMS RECEIVED/SENT declines until four hours of usage; then it levels off at the interesting number of about 7 for three categories until 32 hours is reached; and then the decline continues to 2.3 for the most active category. The ratio of MESSAGES RECEIVED/SENT exhibits the most interesting behavior and corresponds to an intuitive model of user behavior. There is a decline until the 8 to 16 hour range of use is reached, where it levels off until 32 hours of usage, and then begins to decline again. Apparently what is happening here is that a new user largely concentrates on messaging until he or she has formed sufficient relationships or feels confident enough on the system to be encouraged to participate in a conference by writing things. At 8 hours as the message ratio goes up, the comment ratio goes down, and the item ratio holds constant, there is a shift of the same level of effort to conference activity. After 16 hours there is now a continued decrease in all the ratios and it would seem that the conferencing proves to be a mechanism for creating more message activity. This appears to be caused by the formation of new relationships among individuals who discover common interests via the conferencing. One must recall that the EIES population represented many individuals who really did not know one another before their participation. Our intuition with respect to this explanation is based somewhat on observation of what was taking place. As a result the model of the interaction of the message and conference component of EIES is:

Phase One:
Messaging is the primary ccommunication mode: many conference comments are

printed out but not responded to.

Phase Two:
A conservation of effort but a shift to a greater degree of compositional participation in conferencing.

Phase Three:
A build up of effort in composition and increased initiation of messaging as a result of conference activity and the formation of new subgroups.

In a number of experiments of limited duration involving combined message-conference capabilities (e.g. Bell Canada's PDP 11/45 trials in 1976), messaging was used much more than conferencing. For systems where messaging was not available or flexible, the contents of a conference often seem to be largely message like in content. We believe that the limited duration of these experiments, in which a single user may never have accumulated eight or more hours of use, may have been a significant cause of many conclusions. We feel that the EIES experience does demonstrate very different functions for messaging and conferencing. In addition, the EIES message capability is more flexible than that offered on some of the other systems such as PLANET of the Institute for the Future, where a private message may be sent to only one person and there are no group messages as in EIES. Since EIES does have the multiply addressed message and the group message available, the contrast in the use of messages and conferences is more dramatic than for previous experiments on systems such as PLANET.

We have referred to the regular users as somewhat "addicted" to computerized conferencing. One thing that seems to be able to explain this addiction, in theoretical terms, is exchange theory. In its simplest form, as stated by George Homans, (Homans, 1958, 1961)* no person will continue to engage in any

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*Homans, George, "Social Behavior as Exchange", American Journal of Sociology, 62,(May, 1958).
Homans, George, Social Behavior: Its Elementary Forms. Harcourt Brace Jovanovich, Inc., N.Y. 1961

behavior that is not profitable. "Profit" is defined as rewards for engaging in an interaction minus costs. Costs are, essentially, the value of other activities that have to be foregone in order to continue to engage in a particular interactional exchange. If we look at the RECEIVED/SENT ratios we see that in computerized conferencing, even the most active users, "profit"; that is, they receive back considerably more items than they send. The overall ratio for messages received to sent is 2:1 and for conferences it is 8:1. This is not possible in any of the traditional one-to-one communication forms such as telephone calls or the personal letter. Attempts at using the mail in this way (e.g. chain letters) always result in very low exchange ratios.

If the exchange ratios had been 8:1 and 2:1 for all users individually, this would represent equal participation of all members of the system. This occurred on the average for the 32-64 hour usage group.

The total of the ITEMS SENT and RECEIVED per INTERACTION stays around seven for the three most active user classes. It has been observed that human short term memory is seven plus or minus two items on the average and interactive systems designers are well aware of this (Martin, 1973).* It could be that the number of items to be dealt with will stay in the psychologically comfortable range of about seven. One observation that would tend to confirm this is the moans and cries of "distress" from users who have been away from the system for a much longer time than usual for them and who sign on and receive notification of many tens of items waiting for them. Their vocalizations can be interpreted as signs of genuine "information overload". The system, in a sense, seems to condition the user as to how frequently he or she signs on to interact.

The PROPORTIONS of items or text lines which are messages further emphasizes

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*James Martin, Design of Man Computer Dialogues. Englewood Cliffs: Prentice Hall, 1973, p 337.

for SENT items the phenomenon of reduced relative use of messaging to conferencing, and then a relative shift back for the most active users. By these measures the relative shift back to messages does not occur until 64 hours of use. Once again we see that conference items received, when measured by actual amount of text, make up more than 50% of the received communication, even with the composition of conference items only around 25%.

The EFFECTIVE INPUT RATE shows a continual rise to 27.7 words/minute for the most active users. However, this must reflect for this user subgroup a considerable use of the copying and editing capabilities of EIES. This rate includes all interaction time with the system and is derived by merely taking out the time utilized to deliver items at an optimistic rate of 30 characters per second over TELENET. Therefore, these numbers are conservative. Actual measured typing rates by professionals over the PLANET system seem to lie between 20 and 25 words/minute. These did not include interaction with the system. Effective throughput of secretaries including setup time of pages is 16 words/minute as estimated by EXXON in a study of 300 secretaries. The fact that the system does allow this increase of facility with increasing experience is gratifying. However, the rates for beginning users are lower than one would like and we hope the new interface will show a significant improvement in those rates. Ideally we would like beginning users to be able to obtain handwriting speeds of 15 words/minute fairly soon after their introduction to the system.

While overcoming the initial learning curve problem is significant for any interactive system, another problem is the user saturation point, where over the long term a system is not sufficiently rich or flexible to keep up with the user's growing need for new abilities. The EFFECTIVE INPUT RATE may be an indication that we did a better job on that than we did on the lower end. To refer back to our "exchange theory" framework, this growing facility in the

leverage a user has over the system with experience can be seen as another reason why addiction occurs. The system is rich enough so that there are always new features to be learned to meet new needs, each of which makes communication quicker or richer. Thus, time on the system is continuously rewarded not only in terms of receiving more communications than are sent, as discussed above, but also in terms of large, observable gains in communications skill.

The ITEMS RECEIVED and SENT per month further emphasizes that we could have collapsed the categories to 1-4 hours, 4-16 hours, 16-32 hours, 32-64 hours and 64 & Up. It also points out the second threshold of user behavior changes or possibly learning effects somewhere after 16 hours. In terms of the interactive design of systems, we suspect this is the stage often referred to as the point where the user begins to integrate the system into his behavior patterns. Or as we often refer to it, it is the start of "addiction".

The TIME INVESTED/ITEM RECEIVED is much more interesting when broken down by the subgroups. The average (based upon % utilization of the sample) is 3.5 minutes and we will use this as the effective average for planning and analysis purposes. The programmers are largely responsible for the system wide average being 4.79 minutes. However, their use of the system is not going to rise in our operational phase while the user time is going to be much larger. Across the usage categories the initial rise indicates more message sending while the fall after eight hours is more conference activity until the messaging rises again after 32 hours.

The statistics for EIES do exhibit significant differences according to level of usage obtained. They also exhibit properties overall not shown in other experimental systems for either messaging or conferencing. While it is difficult to separate out what factors related to the user population produced these differences, as opposed to integral features of the design, we do feel that the

design as compared to other message-conference systems is a significant factor. The test period has opened up a number of issues and hypotheses so that evaluators of the EIES projects should have a reasonable starting point for their considerations.

F. ERROR FREQUENCIES

EIES keeps a count of how often various error messages are triggered. During the test period very few of the planned commands were actually working and as a result that was the most frequent error message. Because of the development work it was not unusual for some feature or command working for some time to suddenly not be working. However, these counts would include testing by the development staff, typos and communication noise as well.

Errors on EIES are not major penalties for the experienced user as they usually only require supplying a new answer or choosing a different option or way of doing something. For the new user they can be one of the major difficulties in adjusting to use of the system. The following table has a total count of 35,000 errors or 1.2 per interaction on the system. Hopefully the new user materials will go a long way toward reducing some of the trial and error activity that led to these large counts. It is interesting that 332 times someone tried to get on with a valid access code which was already being used. The system, by the way, triggers a message to the person on that someone has just tried to use his or her access code. This is an indication that some sharing of access codes occurs.

Table 15
ERROR MESSAGE FREQUENCY

8293	Invalid Command-please try again
4100	For further help type a question mark (?) or call . . .
3313	That name or number is not on file. Please try again
2882	Invalid conference name or number
2342	Please type "?" for Help
2288	That code did not match. Check the Name or # entry and type a "+" if you need to correct it.
1591	The number that you have entered is not in a valid range
1379	Invalid Syntax
1000	Direct modification is not yet open for use.
946	Invalid Notebook name or number
769	Invalid Text number
728	Item non-existent
710	You are not in that conference
700	On processing .tabs the output became too long.
610	Please enter "Yes" or "No".
528	You are not privileged to access that item.
365	Due to a system error there is a message you cannot receive at this time. A message has been sent to someone who will correct this situation
332	Sorry, That ID is in use
247	Your time allocation has expired. However, we are granting you one hour's grace.
222	Invalid Name or #.
188	Improper sequence of commands
183	Error above arrow
175	No Items have been written yet
159	Invalid Key string
143	Invalid #-# form
132	Enter Yes, No or a Number
121	The following was in error
109	Connection Terminated. Bye!
101	That feature is not open for your use
95	Response is too long
83	You are not in that notebook
74	Attempt to set margin out of range
56	The following is not valid here
46	That item does not exist
36	You are not permitted to write to that item
36	Associations and Sequences are not yet implemented
22	Message System Bookmarks cannot be reset
22	Invalid form of Date/Time entry

G. COMPARATIVE COST AND VALUE CONSIDERATIONS

Our intention in this section is to look at the value of the EIES operation by a comparison to other alternatives. We will first consider different forms of communication before looking at other message-conference computer based systems. Our general observation is that there are no cheaper commercially based systems or options than can do the job EIES was designed to do. Of the experimental or research based systems EIES is unique in terms of its abilities, and we do not see a completely comparable alternative within our current knowledge of research systems in this area. This includes the work on the ARPA net message system, the University of Wisconsin message system, the Wharton School Message system, the University of Michigan's Conference system and the Institute for the Future's PLANET and FORUM systems.

Before we can proceed with the comparative analysis we need to summarize the cost considerations for EIES. Table 16 is summary of the size of the average yearly user population as a function of total user hours and average number of hours a user spends on line per week. The upper left hand corner of 10,000 hours per year and 2 hours per week of average use, with a resulting population of 100 users, is representative of the test period that has been discussed in the above statistical section of this report.

This test period represents the single biggest use of any conference system that has been reported in the literature. However, the OEP use of their EMISARI system over the past seven years may have produced an equivalent amount of usage. Unfortunately that experience has never been analysed and reported in the literature in terms of an analysis of statistics. The Institute for the Future's efforts over 18 months of usage of PLANET and FORUM amounted to 4,687 hours. It is important to note this as we are breaking new ground with respect to understanding the manner in which people use such systems as they gain

experience. Much of this knowledge is crucial to the further development of these systems. In the IFTF experience only 12 of their 500 users utilized more than 64 hours of time, as compared to the 17 out of the user sample of 129 reported for EIES. As yet we understand very little of the characteristics of active users and what we do understand or observe is based upon rather small samples.

The EIES facility is designed to operate during the first year at the 60,000 hour level. This would mean 50% utilization of our incoming lines over the scheduled hours, which are 12 per week day and 8 on Saturday. We suspect the average number of hours on line per week will be between three and four for the groups now coming onto EIES. This means a population of between 300 and 400 can be accomodated. By extending hours it would be possible to increase this level of usage by accomodating those who like to work late night hours and weekends.

Since our costs will be looked at as a function of total yearly hours of usage, Table 16 allows estimates of user population sizes possible with various combinations of total hours of operation and hours per week per user.

Table 16
EQUIVALENT YEARLY USER POPULATION

TOTAL HOURS YEARLY (1000's)	MONTHLY	HOURS USED PER WEEK PER USER				
		2	3	4	5	6
10	833	100	67	50	40	33
15	1,250	150	100	75	60	50
20	1,667	200	133	100	80	67
25	2,083	250	165	125	100	83
30	2,500	300	200	150	120	100
35	2,917	350	233	175	140	117
40	3.333	400	266	200	160	133
45	3.750	450	300	225	180	150
50	4,167	500	333	250	200	167
55	4,583	550	367	275	220	183
60	5,000	600	400	300	240	200
65	5,417	650	433	325	260	217
70	3,833	700	467	350	280	233
75	6,250	750	500	375	300	250

Table 17 provides an analysis of the cost of providing EIES based upon total hours for the year. The TELENET charge is figured on an average cost of $3.50 per hour. This is consistent with our experience as the variable cost factor based on hourly use of TELENET averaged over all users, regardless of which individual TELENET rate they are using (low, medium and high density cities). The center cost is the operation at NJIT and reflects an interpolation between two data points: our test period with the 10,000 hours and the budget for the first operational year. Also, the operational costs do not reflect the money devoted to the purchase and supplying of terminals to some portion of the users. Curently, the center is budgeted to provide approximately 68 terminals distributed among its total population. While the variable cost factor of about $250 per user in the Center's operation is linearized for the purpose of a comparative analysis, in practice it would be much more of a step function as it implies the hiring of additional people.

The total cost of the operation of the center and the TELENET charges is now divided by the number of hours to get a COST/HOUR. We see that for 60,000 hours with a user population range of 200 to 600 users we are still very much in agreement with estimates made in 1975 and published in the Proceedings of the Third Annual meeting of the Conference on Computers and Communications in 1976. That estimate was for $8.00 per hour for a population of 300 users. However, we are not as accurate as one is led to believe. First of all, we have left out of this calculation the EIES development costs of approximately $400,000 for hardware and software. This amortized over a five year period would add $1.33 to the per hour cost. In addition, Telenet increased its effective rate by 50 cents per hour since that initial estimate. Therefore, our error in the per hour charge since 1975 is about 58 cents or within 7%.

Finally, we take the estimate of 3.5 minutes of invested time per user per

item received from the previous analysis and determine a COST per ITEM RECEIVED. It is these two last factors, the hourly cost and the cost per item received, which provide the basis upon which we can make a relative comparison with other alternatives and options. One should keep in mind that $3.50 of the per hour charge or $.20 of the per item charge is the TELENET contribution, beyond the control of the operation of the center. The figures we derive are 8.08 per hour or $.47 per item for a 60,000 hours per year level of operation.

Table 17
EIES COST ANALYSIS

YEARLY HOURS (1000's)	TELENET CHARGES ($1000's)	CENTER COST ($1000's)	TOTAL COST ($1000's)	COST HOUR $'s	COST ITEM $'s
10	35.0	150.0	185	18.50	1.08*
15	52.5	162.5	215	14.33	.84
20	70.0	175.0	245	12.25	.71
25	87.5	187.5	275	11.00	.64
30	105.0	200.0	305	10.17	.59
35	122.5	212.5	335	9.57	.56
40	140.0	225.0	365	9.13	.53
45	157.5	237.5	395	8.78	.52
50	175.0	250.0	425	8.50	.50
55	192.5	262.5	455	8.27	.48
60	210.0	275.0	485	8.08	.47**
65	227.5	287.5	515	7.92	.46
70	245.0	300.0	545	7.79	.45
75	262.5	312.5	575	7.67	.45

* Observed levels or test period

** Budgeted level for facility operation 1977-1978. The third month of the new operation had climbed to the 25,000 yearly hour average at the time this report was being finalized.

Now that we have the EIES costs we need to summarize some other items of data gathered from a number of sources.

1) From the paper "The Evolution of Office Information Systems" by J. Christopher Burns (Datamation, April 1977) we borrow the following values:

Cost of a page of Facsimile	$1.97
Teletype Rate	$2.42 per 66 words
Cost of Internal Memorandum	$4.55
Cost of a letter	$6.41

2) Care of N.J. Bell

Newark to Washington D.C. phone call (3 minutes, prime time)

Station to Station	$1.00
Person to Person	$3.00

3) From a text processing study on 1000 professionals and 300 secretaries by EXXON and reported by Len Keating at the American Management Association meeting on the Automated Office of the Future, Dec. 5-7, 1977:

Cost of a professional person minute	$.30
Cost of a secretarial person minute	$.15
Effective Throughput of a secretary	16 words/minute
Professional handwriting speed	15 words/minute

With the above we can proceed to make some comparisons with the common non-computer alternatives to EIES.

1) Fast Written Forms:

For a 221 word item (the average size of EIES items) we have the following costs:

Facsimile	$1.92
Teletype	$8.10
Mailgram	$3.96
(EIES)	(.45 - 1.08)

2) U.S. Mail

The secretarial cost of preparing a letter is $2.07. We ignore professional time involved in initial drafting or dictation and checking as this would be expended on EIES anyway and at 15 words/minute for handwriting they would seem to be equivalent, based upon the average for the test operation. However, more experienced users are demonstrating 19 or more words/minute and one could make the comparison more favorable by factoring this in. Since average circulation

on EIES is 3 on a per item basis we must divide the $2.07 for typing by 3 to get base costs of $.69. The variable cost per item delivered is either 13 cents or 73 cents if a confirmation is made as exists on the EIES system. The confirmation of delivery of a message or the status reporting of how much everyone has read in a conference is an important part of the psychology of communication on EIES and has been noted by observation to be a triggering mechanism in creating new communications. In addition, a charge per copy of the letter to all three recipients must be included at 5 cents per copy with one copy remaining with the sender. This results in a comparative cost range for the U.S. mail for items sent to three people:

Low Cost= .69 + (.13 + .05) = $.87 per item received

High Cost= .69 + (.73 + .05) = $1.47 per item received

As we see, even the cost of mail is more expensive once EIES usage builds to 15,000 hours per year. As we have stated before this technology is today cost equivalent to the U.S. mail. True costs of mail are a lot higher when one factors in all the other associated costs of filing, storage, etc. and more reflective of the $4 to $6 dollar range found in the literature. EXXON, in looking at their typing of professional pages, found a true total cost per page of text in the area of $20. Even without the inconvenience of mail and the impracticality of holding discussions through the mail, it would prove to be too expensive a mechanism to compete with EIES. Only if all the professionals were assumed to send Xerox copies of long hand written material would it be economically competitive. Furthermore, at many academic institutions the ratio of professionals to secretaries is 10 or more to 1 as opposed to the 3 to 1 common in industry. The secretarial support is not available in most universities to support a mass-mailing of items that tried to replicate EIES with typewritten, copied, mailed, and hand filed communications.

3) Telephone

At a speaking rate of 1.5 words/second we have 2.5 minutes of time needed to deliver 221 words (the average EIES item) over the phone. However this is an investment of 5 minutes of professional time (two people involved) as opposed to 3.5 minutes on EIES per item received. This adds 1.5 minutes of indirect cost or $.45 to the basic 3 minute call. The cost of a station to station call is low because this assumes the party is there at the time the call is placed. We assume one and a half calls are made on the average to reach the other party. The person to person call would be a more realistic option for comparison to EIES and we take that as the upper limit and ignore lost professional time in placing calls that did not reach the other party. This results in:

Low Cost= 1.00 + .50 + .45 = $1.95 per item received

High Cost= 3.00 + .45 = $3.68 per item received

In theory we should multiply these costs by 3 to account for the circulation of an item on EIES, but the costs are already far in excess of EIES. Furthermore, it is very probable that to communicate the same material a lot more words would be needed in a telephone call. However, this latter point is still a conjecture without sufficent experimental backup to measure or estimate such effects.

We have used Newark to Washington D.C. as a typical long distance rate. One may make his or her own assumptions and include the factor of three for circulation and the basic observation will not change.

While we doubt the viability of the telephone for the types of discussions that take place over EIES and the resulting lack of written material or common file ability, even if this were not the case the phone would be out of the running on economic terms.

4) Face-to-Face Meetings

Since the average circulation was 3 items received for each sent on EIES, we will look at a face to face meeting of four people where 3 had to travel to the location of the fourth at a travel cost of 100 dollars (equivalent to Newark to Washington D.C.) and 50 dollars per day expenses. We assume they meet for a full 8 hours per day at a talking rate of 1.5 words per second or 43,200 words exchanged in a day. This is equivalent to 195 EIES text items. These assumptions result in the following comparison as a function of the length of the meeting in days.

COST/ITEM with DIRECT COSTS

Days of Meeting	1	2	3	4	5
Items Exchanged	195	391	586	782	977
Cost/Items($)	$2.30	$1.53	$1.28	$1.15	$1.07

As we see the meeting would have to run for five days before it became cost equivalent to EIES at the lowest usage level. However, this comparison is not completely fair since a person on the terminal at our current rate of 3.5 minutes per item will receive only 137 text items in an eight hour period. Therefore, each person would have to invest 203 minutes every day to receive the additional 58 items over EIES. At 30 cents a professional minute this $61 dollars per day per person must be taken off the face to face meeting as an indirect savings. Then again, the individuals waste travel time in getting to the meeting and for our simple case we shall assume 6 hours there and back total time of travel which is representative of a Newark, N.J. to Washington D.C. trip. If we now add this indirect cost back as well and estimate the cost per item received in the Face-to-Face example as a relative cost to EIES we have:

COST/ITEM with INDIRECT COSTS Or Savings Factored In

Days of Meeting	1	2	3	4	5
Cost/Items($)	$2.71	$1.12	$.58	$.32	$.16

As we see at least a three day meeting is required to become cost competitive with the EIES test operation and a four day meeting is required to become cost competitive with the expected operational levels. This little exercise also assumes it is possible to break up the EIES exchanges into 4 person subgroup meetings and neglects the value of the written form. In addition, the trip used is somewhat optimistic with respect to costs of travel. Finally, it should be pointed out that long meetings (three days or more) are seldom practical or necessary; on the contrary, it is the meeting which lasts less than eight hours which is probably most frequent, and the shorter the meeting, the greater the time and cost per item for the face-to-face condition.

5) Theoretical Throughput Rates

We have been working with a meeting among four persons; in actuality most conferences involve a larger number of participants. At higher numbers of participants throughput becomes important.

As first reported in the 1972 paper "Party Line and Discussion: Two Computerized Conferencing Systems" (Proceedings of the 1st International Conference on Computers and Communications, ICCC-72) there is a point where a high enough circulation rate or conference size over the computer provides a faster exchange of words than speaking and listening. There is a further point of circulation where the savings of time applied to the value of the person's time (using their salary) is sufficient to pay for the cost of the system. This only involves the effective input rate, output rate, circulation and talking rate. In other words when the time per unit word or item on EIES drops below the talking rate per unit word or item EIES is always a time saver. The formula for the throughput rate is:

Time/Word Received = 1/ (CxInput Rate) + 1/ (Output rate)

Where C is the averge circulation or one less than the number involved in the discussion. This is summarized in the following table:

Table of Circulation
(Rates in words/minute)

Input Rate	Talking Rate 90	120
15	8(4)	12(5)
20	6(3)	9(4)
25	5(2)	7(3)

The first number is the circulation rate needed to turn EIES into a time saver over spoken exchange rates. The number in parentheses is the additional increment in circulation needed for the time saved at 18 dollars per professional hour to pay for everyone's use at 8 dollars per hour. While EIES overall circulation is only three and conferences eight on the average, when conferences were emphasized for specific projects during the first six months of operation, the circulation rate was more like 15 for conferences. We expect the higher circulation rates to be more typical of the EIES usage in the operational phase. The above tradeoff assumes zero travel time and zero travel costs so it is very conservative.

Ultimately, we do expect systems like EIES to substitute for a significant percentage of one to three day meetings. The estimates we have just exhibited illustrate that the economics are in favor of this proposition.

Finally we note that improving the output rate (360 words/minute) is not the factor through which the biggest economic gains are made. The circulation rate or the input rate are really the driving factors.

6) Summary

All the above comparisons only exhibit that on a strict cost basis this form of communications can be cheaper than other common alternatives under a wide range of reasonable assumptions. However, what is important is not the efficiency of the operation or its productivity in this narrow sense, but the quality of the resulting communication, which is a much harder factor to assess. For example, we view the message subsystem in EIES as vehicle to improve the nature of a conference. The private messages for individuals and subgroups represent a space where persons can "whisper" about the discussion in a conference. This ability is not very usable in a face-to-face meeting and can lead to disruption if used. The group messaging is a way of avoiding the cluttering of a conference with material that might otherwise interfere with the dialogue taking place. These intentions of messaging can potentially have an effect that leads to better discussion in the computerized conference than might have taken place in a face-to-face meeting. Obviously, this is a hypothesis for which we have no quantification as we have for the economic considerations. The determination of improved quality (or not) and the associated psychological and sociological impacts are ultimately the considerations that will determine the long term success or failure of these systems and whether people will actually use them.

The cost analysis does explain, however, why industry has taken an active interest the last few years in electronic mail. There is a growing realization that letters, mail and travel are not as inexpensive as they sometimes appear on the surface. However, that interest or awareness is still confined to "message systems" and the rather limited view that what one is talking about is a cheaper TWX or Teletype service. The concept of utilizing the computer to structure and facilitate group communications is still rather foreign in the

commercial applications environments and we suspect will remain so for a number of years into the future. It is very likely to take a good deal more research and development of a knowledge base on the impacts of such systems on things like quality of communications before we see commercial availability of computerized conferencing systems.

7) Message-Conference Systems

First we will examine a number of literature sources on costs of Electronic Mail to develop relative costs compared to EIES and then we will make a more detailed comparison with the experiences on the PLANET & FORUM systems of the Institute for the Future. This latter represents the only commercially available conference system to date, aside from the limited OEP Conference package which has been sold to a number of organizations via NTIS.

All electronic mail costs seem to ignore any long term storage costs as they assume delivery of an item is also the act of deletion of the item from storage. However, a conference type of operation must maintain a large file of transcripts of ongoing discussions. In addition we have found the storage of delivered messages for at least a couple of months after delivery proves to be of utility to the user community. It is quite common for comments in a conference or a later message to trigger the retrieving of an older message and reworking of it for further use. Currently EIES has over 250 million characters of storage of which 200 million is available for text item material. This represents a potential for over 50,000 items of text of maximum size. The cost estimates we have obtained for commercial time sharing storage charges range from 10 to 45 cents per 1000 characters of storage per month. To replicate the EIES storage capacity would cost between 240,000 to 1,080,000 dollars per year. At a usage level of 60,000 hours per year this would add between $4 to $18 dollars per hour to the costs we are about to look at for message systems.

In the paper "The Future of Computer Communications" by Vinton Cerf and Alex Curran (contained in Computers and Communications, AFIPS Proceedings of the Federal Communications Commission Planning Conference, Nov. 8 and 9th, 1976, AFIPS press) we find the following estimates based upon 1976 commercial message services:

1000 character message
sent 1 to 1 will cost $3.25
sent 1 to 5 will cost $1.11 or $5.55 for all delivered

Since EIES has a 1 to 3 circulation average for the test operation and an average item size of 1105 characters, the interpolated cost is $1.53 where $2.95 went for composition and $ .64 to deliver each of three copies. This $1.53 is significantly above the $1.08 figure of the EIES test period and does not reflect, once again, storage costs.

In a paper by David Brown ("Teleconferencing and Electronic Mail", EDUCOM BULLETIN, Vol 11, No 4, Winter 1976) reviewing both analyses and experimentation conducted on the Hermes system of Bolt, Beranek & Newman (using both Tymnnet and Telenet), I.P. Sharp's Message System, and Scientific Timesharing's Message System, the following conclusion is made:

"we have reason to believe that no unsubsidized commercially available electronic mail service can currently be used for an average of less than $15 per hour."

The variance resulted in the observation that very short interaction times led to higher average per hour costs and very long interaction times led to lower average costs. On the $15 per hour figure only 15,000 hours of usage is needed for EIES to be cheaper without considering storage costs. With any consideration of storage costs EIES was cheaper for the test utilization.

Tymshare has applied for a tariff to offer a regulated message service over their network and the comparative per item received costs for a message may

obtain the $.70 to $1.00 range. If the $.70 is realized EIES would be cheaper at 20,000 hours of utilization without storage cost considerations.

Currently most commercial time sharing systems base their rates on a set of functional charges which are not always translatable on an analysis basis to a user transaction such as sending or receiving a message. To make estimates properly one has to actually experiment with the system concerned. It is for this reason we are relying on secondary sources for the above estimates.

The PLANET and FORUM systems of the Institute for the Future represent a system intended to provide conferencing capabilities. Under their research activities they have accumulated 4,687 hours of use over an 18 month period, a good portion of that operational on commercial time sharing systems such as Tymshare. A recent report ("Computer Conferencing in the Geosciences by Jacques Vallee, et. al., prepared by IFTF for the U.S. Geological Survey, September 1977) summarizes their experiences with a group of 141 geologists who utilized 1,100 hours of time over a 15 month period. The following data are taken from that report, with the exception of those marked with an *, obtained via a phone call to IFTF:

Hours = 1140
Sessions = 10,839
Messages = 4,825
Circulation of Messages = 1.00
Comments = 3,613
Circulation of Comments = 8.61*
Average Cost per Hour on Tymshare = $16.45
Average Size of Message = 47 words*
Average Size of Comment = 63 words*

Using the data provided on individual users the following summary table was put together for a comparison with the EIES user sample.

SAMPLE		AVERAGES		
Use Range (hours)	Number of Users	Usage (hours)	Times On Number	Session (minutes)
64 & Up	2	88	865	6.1
32-64	6	46	421	6.5
16-32	14	21	196	6.4
8-16	20	11	121	5.5
4-8	9	5	65	4.6
2-4	25	2.5	23	6.5
1-2	20			
0-1	29			

Unfortunately there were no data on items received by individual and rounding in their table prevented carrying out averages on session length for those under two hours. The total in this sample is 125 users which accounts for the hours but not the 141 figure quoted from the beginning of the above report. PLANET is a very simple system to use so we suspect the learning time is under an hour, so that it would seem 29% may have not made it over the learning period. In the 1-2 hour range the same characteristic of almost no messages written is present in this sample as was observed in the EIES case. So another 16% did not really participate in a compositional sense. To this extent the results are similar to the EIES experience. However, a number of startling differences occur as we examine the rest of the data. One such contrast is that only two of the PLANET users spent 64 hours on line, even though they had a 15 month period of usage.

Based upon the circulation rate for comments and the fact that a private message can only be sent to one other person, we find the total number of items received is 35,932, of which 13% are messages. In the EIES experience 50% of items received are messages. It could very well be that the restrictive message capability leads to a lot of text items entering conferences that could have been better handled as messages. This may be one significant factor in the design which accounts for the closeness of the average sizes of messages and comments in the IFTF experiments. It may also be that the added message-like content, in the conferences, if true, detracts from the pressure to invest think time and preparation of comments and leads to generally smaller items than used in conferences on EIES. In addition the use of a double carriage return to end comments on a full duplex system and the inability to edit a stored comment may lead to a significant number of single statements inadvertently being broken into fragments.

The time invested per item received is 1.9 minutes. If we use the higher estimate of 63 words as an average item size this would indicate 6.66 minutes investment of time for an EIES sized item of 221 words. Using 6 words per second as output rate we have 105 hours necessary for output, which leaves 1035 for input of text. Since 8,438 items were written and still assuming the 63 word average, we have the effective throughput rate of 8.6 words/minute as compared to the 15 words/minute on EIES. However, the 8.6 rate is characteristic of the EIES users with about 8 hours of experience, which is about their average per user in this sample. The IFTF systems operate in a full duplex mode and the tradeoff between full and half duplex is a controversial subject among designers that is unclarified by any carefully controlled experiments. It is a good example of an issue that has not received the evaluation research it deserves. If the IFTF users on Tymnet had some of the slowdowns we experienced,

full duplex might have played a bigger factor in reducing the input rate for them than it did for us. We suspect that slow full duplex interferes more with think time in the composition process than does slow half duplex. What people usually neglect in considerations of interfaces is the impact of less than optimum conditions on the design.

Their average circulation factor is 4.25 and somewhat higher than EIES's factor of 3, a ratio of 1.42 between the two. However, when normalized for average item size the ratio reduces to .42. This latter comparison assumes there is a value to larger items being circulated. The differences here we feel are also associated with the design of their message subsystem and its relation to the use of the conferencing. However the time invested per word received is much closer to EIES because of the higher average circulation: 1.8 seconds/word for IFTF and 1.5 seconds/word for EIES.

The IFTF report did provide the total number of items sent per user which allows us to calculate the following averages:

USE RANGE (hours)	ITEMS SENT/ PERSON	ITEMS SENT/PERSON & SESSION
64 & Up	1004	1.2
32-64	290	.7
16-32	151	.8
8-16	67	.6
4-8	26	.4
2-4	12	.5
1-2	2.9	
0-1	.3	

The above is not dissimilar from the EIES distribution but represents a narrow spread and less participation at the higher end of the usage range. The characteristic of less composition activity for lower usage users is also common to both systems.

One must consider that the users on EIES were self selecting in that there was no requirement for the majority of them to participate. In the IFTF case the majority belonged to a single organization and may in some individual cases have had to make a show at participating when there was no real personal motivation to do so. Another potentially important difference is the lack of a charge for time on line during the pilot EIES period.

The above data allows us to construct the following comparison table:

	IFTF	EIES TOTAL	EIES SAMPLE
ITEMS RECEIVED/ SESSION	3.3	4.3	5.4
ITEMS SENT/ SESSION	.8	1.4	1.8
TOTAL TRANSACTIONS/ SESSION	4.1	5.7	7.2
SESSION LENGTH minutes	6.3	20.7	18.1
SESSION RATE (words/minute)	41	61	88
ITEM SIZE (words)	63	221	221
CIRCULATION	4.25	3.00	2.93
EFFECTIVE INPUT RATE (words/minute)	8.6	15	24
TIME/WORD RECEIVED (seconds)	1.8	1.5	1.0

In the above table the SESSION RATE is a figure derived from the number of transactions per session times the average item size divided by the session length. For face-to-face or spoken conversation the session rate is 90-120 words per minute.

The fact that the EIES andd IFTF approaches to computerized conferencing start from two very different philosophical bases is expressed in the following quote from a recent IFTF report (Johansen, et. al., 1977)*

> There are differences of opinion, however, over what comprises "computer conferencing." In the New Jersey Institute of Technology system, for instance, computerized conferencing is combined with other computer resources, such as a journal system, a text editor, and even a kind of management information system. While such a system provides more computer power, it does so at the expense of the simplicity of operation we felt was necessay for an initial exploration of the utility of small group communication through computers. PLANET is a simple system which enables social scientists to explore the potentials of computer conferencing without requiring that they control for the effects of peripheral elements involved in more complex computer services. Our approach has been to base our assessments of computer conferencing on this basic system for group communication through computers.

The philosophy of design that underlies EIES has always been that the objective of computerized conferencing is to utilize the computer to tailor communication structures and to build as an integral part of such communication structures any computer aids or functions that would act to facilitate the communication process. Therefore, EIES, as a system designed for long-term use by scientists, is designed as a rich and complex system to meet what are felt to be a diversity of needs. It is actually very useful that the two major efforts in this area today have approached the endeavor from two very different directions. The state of the art is such that a diversity of views and directions should be taken. It is quite clear from the results to date that there are very distinctive differences in results. Out of diversity often emerges knowledge.

There are many possible explanations for the differences between the IFTF experience and that of EIES. Since the majority of their users were with one government agency, organizational factors and roles could have played a signifi-

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*Johansen, Robert, et. al.: Group Communication Through Computers Volume 5; Effects on Working Patterns, Institute for the Future, Nov. 1977, Report SR-96

cant part. A significant number of the text examples in their report applications were of a project management or coordination nature. From the experience at the Office of Emergency Preparedness project coordination does tend to lead to fairly short text items as they are often statements of status, actions taken and requests for information. It would have been interesting for their application to have looked at the relative rank or position in the organization of persons and whether that had any correlation to activity. The experience at OEP was that the higher up one went the greater the tendency toward receiving a lot more than sending. Also, the report indicates that a significant number of simultaneous sessions were held and that the average item size during simulataneous sessions is significantly smaller than for the more normal non-coincident use. This would conform to observations of the few simultaneous sessions held on EIES.

However, we also believe the design is a key factor and that the structure of EIES encourages people to think off-line a lot more about conference comments before responding to what is new in a conference. We strongly suspect IFTF conferences take on some degree of message-like content which would in turn create a pressure for immediate answers and result in smaller items overall. Encouraging simultaneous use has a similar effect.

The more or less constant length of session regardless of level of usage indicates that users have mastered the system at a fairly low level of usage. This has its merit but it also represents a limitation on the options available to the users by decreasing the functions to which they can apply the system. IFTF chose to design a system that would provide the conference capability as simply as possible, whereas in EIES we have chosen to design a system capable of encouraging a great deal more composition and communication alternatives.

In addition, there is no centalized directory in the IFTF systems through

which users can form their own groupings and no complete freedom to form their own discussion groups via private conferences. While the FORUM system does allow more flexibility in terms of voting and Delphi-like options, it would also be more expensive to run on a commercial basis than the $16.45 quoted for the PLANET operation. Some use of voting was reported for that part of the operation that used FORUM. However, FORUM still has the same message and text editing and copying limitations that PLANET has.

We do feel that EIES has exhibited significant differences from the PLANET-FORUM experiments as well as the use of other Message or Conferencing systems. A complete understanding of why is still a matter of conjecture. The test operation has raised, however, a rather rich set of hypotheses about what might be the underlying causes of some of these distinctions and it is hoped that the operational trials will be able to shed more light on these issues.

SUMMARY HYPOTHESES

The statistics alone are insufficient to explain what is taking place and must be supplemented by other direct forms of data collection and analyses such as surveys, interviews and controlled experimentation.

The most interesting of the observations from EIES during the test period and the cost comparisons with other media might be summarized as a list of hypotheses.

NEW USERS

1. A new user is usually passive in terms of receiving a lot more than he or she sends relative to more experienced users. A new user is more likely to send messages than engage in conference activity.

2. A new user's motivation is likely to depend upon the availability of individuals he or she desires to talk to and the availability of interesting topics in on going discussions; (attractions). Barriers are the other aspects of new user motivation, in terms of access to terminals, inadequate user training materials, or system problems.

REGULAR USERS: CONTINUED LEARNING AND CHANGES IN BEHAVIOR

1. Users evolve specialized norms with respect to the use of the facilities and communications and writing style. The acquisition of these norms by individual users and groups appears to be an important learning process on such systems.

2. User participation in conferencing in an active sense of contributing items seems to require some degree of usage above the basic level of learning the mechanics. This may be a second level learning plateau involving the acquisition of norms established by the user communities.

3. Users will gain facility as time passes so that their input rates become higher than usual typing rates. For large groups, the time required to send and receive communications will drop below that required for other media, such as

telephone or face-to-face meetings.

4. The user's short term memory may be a factor in conditioning his frequency of interaction with the system. Users will tend to become conditioned to sign on the system so that, on the average, they have about seven items to send or receive per interaction.

5. In accordance with social exchange theory, no participant will continue to use a conferencing system unless their "rewards" are greater than their "costs". Among the factors which increse reward for users are

1) Ratio of items received to items sent. This increases with

a) size of active group

b) throughput rate of the system

2) Observable increases in skill and speed in using the system. This is related to the richness of the design in terms of advanced features available to users once they have mastered the basic mechanics.

3) Importance of communication with system members in comparison with communication with persons not on the system; relative cost in time and money of other modes for communicating with people on the system.

MESSAGES VS. CONFERENCES

1. There is a greater effort in the preparation, composition and think time devoted to comments than to messages.

2. A movement of new people into an ongoing conference is a common characteristic of this form of conferencing.

3. There are distinctive and significant differences between messaging and conferencing as used on EIES. Furthermore, the relative usage of the two is a function of the degree of user experience. Conferencing for the more active users seems to act as a stimulus to messaging activity.

INFLUENCE OF DESIGN

1. The design of a computerized conferencing system will affect such user behavior patterns as the average length of items entered. The ability to copy, edit and retransmit items, or move items freely between messages and comments or pages is an important factor in improving the effective throughput rate of the system and the ability for the user to incorporate this type of sytem into his or her daily communication behavior.

2. It may be important to have available for new users sufficient public material to stimulate interest, and to allow browsing which will develop common interest subgroups.

3. The EIES system is cost-competitive with the mails, and is cheaper than telephone or face-to-face meetings in most circumstances.

FUTURE OPTIONS AND DIRECTIONS

The development of and experimentation with EIES represents a particular implementation of a computerized conferencing system tailored to facilitate scientific and technical communications. As both a new medium of human communication and a new area of computer application, there are a number of future options and directions suggested as a result of this research effort. This section is intended to provide an overview of what are felt to be significant areas deserving further exploration.

The first category of exploration is to extend the population serviced by EIES to service aspects of science information beyond that of the exchange of recent research findings among scientific communities. However, all these extensions imply a greater emphasis on controlled experimentation, rather than the field trial atmosphere of the current EIES operation. The particular areas worthy of attention are:

Peer Review

The EIES system could be utilized for peer review of grant proposals and provide a medium where the reviewers can engage in a discussion among themselves as well as with those involved in making the proposal. There are several hypotheses which could be examined by careful experimentation as to the relative benefits or drawbacks of utilizing this form of communication for peer review compared to current practices. (See Hiltz and Turoff, 1978.)

Management and Sponsorship Involvement

Systems of this sort offer the ability to foster a closer involvement of sponsors and managers in the ongoing research process. It is not clear that this is desirable in all potential areas, and deserves rather careful exploration.

R&D Management, Technology Management, Standards & Research Planning

All these areas represent the management decision and problem solving process, as applied to science and technology. Very often they involve the extensive use of committees and in so doing lend themselves to comparative experiments utilizing the computerized conferencing environment.

Handicapped Scientists

What special terminals or interfaces would be useful for blind scientists or for others with physical disabilities?

Technology Transfer

The process of transferring technology across disciplines, from the laboratory to practice, or from developed to developing countries, all appear to be an open area for investigation.

Consulting

Not only does this medium provide an ability for consulting, but it offers

significant new options for group and team consulting as well as improving the ease with which those with problems and those with solutions can find one another.

Policy and Assessment Analyses

The exploration of the consequences of scientific research and technological development would appear to be one of those areas that is not dealt with adequately by current communication processes. The computerized conferencing environment appears to provide the "cool" sort of communication forum where parties representing widely different interests and views could perhaps confront one another in a more deliberative and informative manner.

In addition to the extensions into additional application areas there are a number of technological enhancements possible that appear to hold benefit for EIES type systems. Most of these require some degree of research in terms of user interface design as opposed to any technological development.

Interconnect

The members of a scientific group should be able to make available to members of their research community the information provided by the computer data bases and models they individually have available. NJIT has been exploring this, under a separate research effort, in the form of a microprocessor that can dial up a computer system and simulate a human's interaction. This allows the microprocessor to serve as an interconnection device between EIES and other computer systems. However, there is much design work and experimentation to be done in this area.

Translation

Can a bilingual or multi-lingual system aid international scientific commu-

nication? Might a multi-lingual interface (for example, English, German and French plus translated titles and keywords suffice?

Analytical Decision Aids

The use of computer abilities to process and analyze the subjective judgements of a group of humans is still a wide open research area in terms of the integration of these techniques into computerized conferencing environments. The extension of EIES to include R&D Management activities and such things as the rating and classification of goals, objectives, tasks, and the setting of standards, could well benefit from further emphasis on this area.

Equation & Photo Composition

There is no photo composition system today for producing equations which is meant for utilization by the end user and which allows the specification of equations so they may be used as a part of the communication process. The enhancement of EIES to allow the transfer of equations in a standard representation language for all conferees, and at the same time allow the production of a photo composed output, would represent a major extension of EIES to service a wider scientific audience.

Interface Tailoring and Forms Control

Capitalizing on other development activities at NJIT, the EIES system has the ability to tailor interfaces to particular individuals or groups. It also can allow for the soliciting of information by presenting on-line questionnaires and forms. However, the use of this technology still requires some degree of experimentation within specific application contexts.

The final area of consideration is the need for economic and policy analysis studies related to any ultimate widespread use of systems of the EIES

sort. The issue of ownership of information and/or authorship is one that deserves further investigation. It seems that we are still in the position of having laws and policies established in this area in response to current problems, with little forethought as to future implications of an experimental facility such as EIES.

Another area is the impact of alternative charging practices and the incorporation of royalties into systems of this sort. This issue is open to both analysis and experimentation. This also ties into the long term impact on journals, preprints and reprints, as well as to the function of professional meetings.

Conclusion

To summarize, we have implemented a system which represents a starting point in terms of communications features and methods for assessing their impact upon the scientific communication process. The system is a promising test bed for more controlled experimentation with specific features or augmentations, and for new kinds of applications. In addition EIES is capable of supporting controlled experiments and field trials in other areas of information exchange than that of scientific and technical information. The basic structures of messages, conferences and notebooks apply to almost all human information exchange activities.

Publications Containing Material on EIES Effort.

Featheringham, Tom 1977a — Present and Potential Value of Computer Communications in Information Science, The Value of Information. Proceedings of the ASIS 6th mid-year meeting. May 19-20, Syracuse University, Syracuse, N.Y. This paper reflects on several areas where computer conferencing systems might have greatest impact on future information systems users. Among these are the potential automation of the authorship, peer review, and refereeing activities of the normal scientific publishing process. Also, the coupling of computer conferencing systems with on-line storage and retrieval systems will provide the future information seeker manifold knowledge resources.

Featheringham, Tom 1977b — Teleconferences: The Message is the Meeting
Data Communications (July)
Computerized conferences have the potential for improving and radically altering the way business information flows, but are no cure-all for bad management.

Featheringham, Tom 1977c — Computerized Conferencing and Human Communication
IEEE Transactions on Professional Communication
(December) EIES systems characteristics are reviewed from the standpoint of human characteristics. Systems usage, the information overload phenomenon, and shifts in language styles are discussed.

Hiltz 1977a — Computerized Conferencing: Assessing the Social Impact of a New Communications Medium. Technological Forecasting and Social Change Volume 10, Number 3, 1977.
A description of the use of EIES for laboratory and field experiments on the group communication process. (Initially presented at the American Sociological Assn; New York, September 1976).

Hiltz 1977b — The Human Element in Computerized Conferencing Systems
Paper presented at the American Society for Information Science, Chicago, September 1977. Submitted to Computer Networks. This gives the results of the evaluation research effort as of the end of August, 1977, incorporating follow-up questionnaire responses from 54 of the EIES users during the pilot period.

Hiltz 1977c — The Impact of a Computerized Conferencing System Upon Scientific Research Specialties
Initially presented as a working paper at AAAS, Denver, February 1977. Forthcoming in Journal of Research-Communications Studies.
This paper describes in detail the quasi-experimental research design and hypotheses being tested for evaluation of the impact of EIES upon scientific user groups.

Hiltz &Turoff 1977a — Effective Communications Structures for Technology Assessment. Chemical Marketing and Economics (Reprints of that Division of the American Chemical Society), 1977 LC No 77-72678
This paper explores the potential role of computerized conferencing systems such as EIES in the process of Technology Assessment.

Hiltz & Turoff 1977b — Overview of EIES and Its Implications Transnational Associations No. 10, 1977.
This is a special issue of the magazine of the Union of International Associations devoted to computerized conferencing. It abstracted a significant amount of material by the authors from many of the above references.

Hiltz and Turoff 1978 — The Network Nation: Human Communication Via Computer, Reading, Mass: Addison Wesley, forthcoming.
A comprehensive treatment of the history and future of computerized conferencing systems, including applications to such areas as scientific communication and public use: design choices and economic factors; and social-psychological impacts. This book abstracts some material from published EIES reports.

Turoff 1976 — The Cost and Revenues of Computerized Conferencing. Proceedings of the Third International Conference on Computers and Communications, August 1976.
This paper provides an analysis of costs and revenues for computerized conferencing systems, utilizing the data and experiences resulting from the EIES effort.

Turoff 1977 — An On-Line Intellectual Community or "MEMEX" Revisited. Technological Forecasting and Social Change, Vol. 10, 401-412, 1977 (Originally presented at AAAS meeting, Feb. 1977)
This paper examines the long term implications for scientific communications resulting from EIES type systems.

Turoff and Hiltz 1977a — Meeting Through Your Computer. IEEE Spectrum, May 1977
This paper provides an overview of computerized conferencing efforts and some of the potentials for the applications of this technology. EIES is treated extensively as an example of current efforts.

Turoff and Hiltz 1977b — Computerized Conferencing: A Review and Statement of Issues Paper presented at the NATO Symposium on the Evaluation of Telecommunications Systems, Bergamo, Italy, September 1977. Proceedings to be published by Plenum.
Focussing on the policy implications of c.c. systems, this paper also reviews the history and near-future characteristics of these systems; potential applications; the problems of impact assessment.

Turoff, Vallee, and Smith 1976 — Computer Conferencing - A New Medium. MOSAIC, Vol 7, Number 1, Jan/Feb 1976
An overview of computerized conferencing with a description of the EIES effort.

Turoff, Whitescarver, and Hiltz 1977 — The Human Machine Interface in a Computerized Conferencing Environment. Proceedings of the IEEE, Man Systems & Cybernetics Conference, Washington, Sept. 1977.
An elaboration of the design principles behind the EIES interface design and some preliminary analysis of user reaction to the design.