Dissertation Proposal

Wendy E. Mackay
26 November 1989

Introduction

My research interests have been driven by the desire to help users obtain the information they need, as they need it. This requires an understanding of the user's information needs and how they can change in the context of the user's work. Since a key method of obtaining useful information is through communication with other people, I have focused on the role of electronic communication systems in work and learning. I have been working to develop a theoretical understanding of users' communication patterns and to gain insights that will allow me to increase the effectiveness of electronic communication systems.

What has become apparent in the course of my work is the dynamic interplay between people and the software they use. Software does not occur in isolation; it must be examined in the context of a constantly changing work environment. Electronic communication systems are interesting because their use often reflects these changes within an organization. Electronic mail both affects the communication patterns within a organization, by changing communication costs, and is affected by the existing work and social patterns of the organization. In addition to communication, it is used to coordinate activities and allocate tasks, prioritize work, and provide a record of useful information.

People in an organization adapt electronic mail to meet their needs, making it a useful test case for studying user innovation. We can explore the circumstances under which users innovate and whether or not these innovations can be predicted by the developer of the software. If they cannot be predicted, it may be possible to change the software development process to facilitate user innovation.

---- Why study electronic mail? Helps us to understand communication patterns in organizations and their relationship to organizational behavior. Helps us to look at work patterns and see how they evolve, especially in reaction to changes in technology. Provides a way to explore how users innovate. ----

The study of electronic communication should provide useful insights into communication patterns within organziations, cooperative work and user innovation. Similarly, these different perspectives can provide useful insights into the design of more effective electronic communication systems.

Research Plan

I have conducted research in several areas over the past three years at MIT. I have worked on theoretical issues related to electronic communication, specifically user access to and control over multi-media information. I have conducted empirical studies electronic mail use and have studied how users users filter and annotate messages. I have developed tools and a methodology for analysis of video data of software users. I have managed the design and iterative development of two major software projects, Pygmalion and Argus, which reflect the theoretical work and empirical findings. Much of the work has already been published[1].

I would like to base my dissertation on this body of work, with primary emphasis on the three refereed publications listed below. I plan to reexamine this data from three different perspectives: the effect of electronic mail on communication patterns in organizations, the role of electronic mail in supporting cooperative work and as a mechanism for studying user innovation of software.

In order to do this successfully, I propose to conduct a final set of interviews with 14 of my previous subjects and develop a set of in-depth case studies. These subjects are experienced electronic mail users and have used one or more versions of a rule-based electronic mail filter (Information Lens at MIT, Common Lens at PARC and Argus at Athena), which provides users with the ability to modify their processing of their electronic mail. The final interview data will be combined with my previous interview and usage data. This data will help to address the following questions:

1. What are the characteristics of different communication channels that cause users to choose one over another?
2. Can we predict the dimensions along which users will innovate? If so, what are they?
3. What are the implications for the design of electronic communication systems?

Proposed dissertation outline

Introduction and Literature Review

Pilot Data: Summarized from published papers.

Case Study Data: 14 case studies.

Analysis: Evaluation of data from three perspectives.

- Communication Flows
- Cooperative Work
- User Innovation

---

[1]Please refer to my curriculum vitae for a list of publications.

Conclusions and directions for future research

Appendix

Mackay, W.E. (October 1988). Diversity in the Use of Electronic Mail: A Preliminary Inquiry. *ACM Transactions on Office Information Systems*, Vol. *6*(4).

Mackay, W.E.,Malone, T.W., Crowston, K. Rao, R., Rosenblitt, D. and Card, S. . (May 1989). How do experienced information lens users use rules? *CHI '89 Conference on Human-Computer Interaction*. Austin, Texas: ACM/SIGCHI.

Mackay, W.E. and Davenport, G. (July 1989). Virtual Video Editing in Interactive Multi-Media Applications. *Communications of the ACM*, Vol. *32*(7).

Proposed Schedule

September	6-8 in-depth interviews/case studies at MIT.
October	6-8 in-depth interviews/case studies at Xerox PARC.
November	Writing.
December	Writing. Complete draft: December 15.
January	Revisions. Defense: end of January.

Review of Chapters

Introduction and Literature Review:

Exploring how people use, modify, and are changed by electronic communication systems.

Pilot Data: (Summarized from published papers)

Diversity in mail use, work activities supported by email, innovations in rule use, inaccurate predictions of rule use, and user control of information (text, graphics and video) in electronic communication.

=== Electronic communication systems are here to stay. Their benefits are increasingly recognized throughout industry, government and academia. Effective management of on-line information has become critical to success.

If the short term costs of categorizing and managing on-line information outweigh the long-term benefits, users will resist taking advantage of tools that would otherwise be highly beneficial. (Cite behavioral literature on short-vs-long-term reinforcement, cite evidence that people do not manage information well).

Preliminary Results: Electronic communication systems evolve and are adapted by users to meet individual and group needs. These adaptations affect the kinds of messages sent and reflect the evolving needs of the organization. Many users become overwhelmed and find it difficult to manage the increasing volume of information (Mackay, 1988). Tools such as the Information Lens are designed to help users manage large quantities information. However, they are utilized far less than the benefits would suggest (Mackay et.al, 1989).

Because the benefits are so great, some users (lead users) will create customized tools to address individual problems. However, the majority of users do not have the technical skills, even if they have the need, to successfully manage their on-line interactions. To increase the usefulness of such systems, we need to understand how to lower the short-term costs of managing the information.

Barriers that increase the cost of managing electronic information:

1. Users who manage their own messages often do not have clearly articulated rules for how they do it. Most people, except those with extreme needs, will resist articulating these rules.
2. Users have misconceptions about what they actually do with electronic mail (Mackay, 1988, others), which makes articulating effective rules even more difficult. Observing user behavior and either operating directly as a result (Weckler, neural net work) or providing feedback to users (Mackay, others, tutoring work) will be more effective.
3. Pre-categorization of messages by senders will be most helpful in situations in which communication patterns are highly regular or the content of the message is the major indicator of how the message should be processed. The information lens should prove useful here.
4. Recipients of messages react to the same message differently, depending upon previous interactions with the message, changes in the external environment, and changes in the user's interests. Providing flexible annotation (categorization) mechanisms to recipients, that can be used differently when the user's state changes, will prove more effective than fixed annotation schemes.

Case Study Data:

14 case studies of people who have used and modified their electronic communication. Pre and post interviews, recorded mail and rule usage data.

Analysis: Evaluation of data from three perspectives.

Communication Perspective:

Some characteristics of electronic communication change overall communication patterns. Identify these and suggest a design that lets users explicitly control them. Examine how these characteristics affect user choices over which form of communication to use.

Data gathering technique: List of questions:

For which types of activities to you prefer: ftf, phone, email?

Separate list of questions: when you need technical info, what do you do? negotiate? plan... etc. Make a list. Get lots of people to fill it out.

Cross-check the two lists. Check with case studies -- what would be predicted? Follow someone around with a video camera for a day and see what they actually do. (Since we know they don't do what they say they do.)

Identify the underlying aspects of the different activities that cause the user to choose one communication channel over another. How many of these things can be placed under user control in an electronic system? What are the advantages of doing this? What are the costs (e.g. making users explicitly choose may be more cumbersome...a phone is a collection of features -- what are useful collections of features. Reorganize them in ways that are most commonly useful, then let users modify the collections of features if they need them for something else. Just pointing out that they can think about communication along those lines may be useful.)

Coordination Perspective:

Certain characteristics of electronic communication are ideally suited to helping people coordinate their activities. Identify these characteristics, compare role of Formal vs. informal message types and explicit vs implicit specification of rules.

Discussion about why people don't use message types...must prethink them. Must be explicit.

Can coordination of activities really work if people have to explicitly name what they're doing, as in the coordinator?

Innovation Perspective:

Users modify their use of the software, and the software itself, to meet their changing work needs. Software designers are often unaware of these modifications, nor are they able to incorporate them..

Users have varying incentives and abilities to improve how particular software packages affect their work patterns. Even software explicitly designed to be customized by users can only be customizable along certain dimensions. Explore the extent to which designers can predict these dimensions along which users innovate, and strategies for identifying profitable innovation areas (learning by doing, iterative design).

Patterns of electronic mail use are dictated by that environment and affected by changes in the user's personal situation and work assignments.

Users may innovate, sometimes along lines intended by the designer of the software and sometimes in unanticipated ways. These innovations, in turn, affect the work done by users, the communication patterns, and they ways in which they work with others in the organization.

Introductions of new software and the user's customizations of existing software not only changes how effective the user is accomplishing work, but also what the user does and how that work is defined.

From a user's perspective, the system is only the set of available functionality, which can be used in the ways intended by the designer or in completely different ways.

Software tools that reveal information to the user about his/her own work patterns, may fundamentally change the ways in which the user works. The changes in the tool itself may also change the way the user works. Changes in one user may affect other users, which in turn affects the first user. (System dynamics model here...)

Software developers often develop software as if it will be used in isolation, in a static environment.

Most software is designed as though it is static -- at least temporarily, during a particular release. Software designers are generally unaware of how users will use their software and how it will be used in conjunction with other tools in the work environment. Although software is increasingly likely to be designed to be flexible, it is not clear how designers can know which dimensions are most likely to be useful? Is it possible to predict?

Conclusions:

Summarize the conclusions drawn from the analysis sections and suggest directions and strategies for future research.

I hope to find new insights from examining the data from these three perspectives and perhaps provide insights to each of those approaches as well.

I propose to reinterpret my work from three different perspectives.

The members of my committee represent three related sets of interests that may be summarized briefly as: user innovation (Von Hippel), communication flow (Allen), and cooperative work (Malone). Electronic communication provides a testbed for all three perspectives.

**My research interests have been driven by a desire to better understand the role of electronic communication in work and learning.

Can use electronic mail to study what makes users innovate. They have changing needs, many of which can be measured, and we can examine the results of the innovations and compare them to the kinds of modifications expected by the designers.

Can use electronic mail to identify communication patterns within an organization. (Particularly if you also look at off-line communication, such as phone and face-to-face.)

Can use electronic mail to study how people coordinate their activities.

Independently of all this, can look at users and start to understand what provides the most efficient strategy for giving them access to the information they need.

---

let it be customizable along useful dimensions

easy to change in the face of changing work conditions

informative to user about own work patterns (learn by doing)