ELECTRONIC COMMUNICATION:
A CO-ADAPTIVE SYSTEM

by

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Abstract

Distributed networks of computers have provided new channels for communication within organizations. Over the past few years, numerous software packages have been created to provide different kinds of functionality to users. The collection of programs appears random, based on historical accident and preferences, yet together they provide users with a system of communication paths and provide a range of communication possibilities. (I include the telephone, FAX and other forms of technologically supported communication devices.)

The purpose of this dissertation is to explore the characteristics of such systems of communication packages and to claim that together, they represent an excellent example of a *co-adaptive* system. I will present a framework for discribing the development of such systems, methods for observing them, and examples of software that encourages it.

1. What is a co-adaptive system?
2. Why is it good to have co-adaptive system?
3. Can we predict when they are likely to occur?
4. Can we encourage them? If so, how?

At the end of this thesis, I hope to have introduced and explored the concept of co-adaptive systems, using electronic communication as a key example. I want to use this to explore electronic communication itself -- how it changes from "off-line" communication -- both the content of what's said and the patterns of communication. I want to create a framework for future electronic communication systems that permits the kinds of flexibility required for further communication and describe prototype software that has been developed to demonstrate these ideas. I would also like to propose a process for observing, studying, developing and incorporating the "research process" into the development process (everyone's a scientist!). Finally, I would like to take a meta-level view of this approach to research, which I believe is an important combination of techniques necessary to understand and improve the complex rapidly changing systems of today. (ie. psych methods aren't sufficient -- need to reexamine the nature of control.)

Thus, this is a series of essays on the following topics:

1. electronic communication in the context of organizations (observation, data, analysis) (cost-benefit analysis -- who does what)
2. co-adaptive systems (observation, data, analysis) (what causes them to occur?)
3. a theoretical framework for electronic comm (source: examine real systems from a different perspective)

4. software to support the framework (design decisions and feedback re: argus, pygmalion, tutor and its)
5. research methods for studying the software development process (external observer, iterative design, general oz, eva)
6. incorporating the research methods into the process (participant observer, feedback to users, video prototyping)
7. meta-level view of the research method (reassess methods of control, combine lab, field, theory. Build, test, observe, integrate)

I am specifically interested in electronic communication for a variety of reasons. One -- the Zuboff style notion of "informating". Two -- related idea of empowering. Three -- teaching. Four -- increased innovation. Five -- increase productivity. Six -- increased work satisfaction.

Communication networks reflect the organizations -- very hierarchical ones look hierarchical. (Do people copy every body up and down the line "Everyone is equal, all the way up and down the line" -- from a military person, the only one in favor of Winograd's software.

In this thesis, I claim that the organizations that used these nets co-opted from from their original purpose (rand study) and that email and other stuff evolved over time. Thus, we can use the history and lessons of email to examine this co-adaptive process and explore a few examples in depth. then extend it to other forms of systems in which the users and the technology influence each other -- propose a new model of describing the development of innovative technology in which ...

Various kinds of software have been developed to support this -- I am interested in how groups of users and individuals change the software (electronic communication) environment to meet their changing needs. I call this a co-adaptive system -- one in which the user's behavior is influenced by the introduction of new software, new features and new combinations of software and they simultaneously change the software.

Some of those changes are direct -- either the programs have features that users can change or some of the users are programmers or people devise clever ways of using other techniques to use the software.

(What about learning to program with TECO (me) -- to do data analysis --- and SCRIBE (for steve to do his thesis). Who learns to be a programmer? (Any field - the common problem for graduate students is to get "seduced by the computer"). What are the motivations -- rapid feedback and progress toward a self-defined goal. Graphics/old computer games drove first set of programmers. But other flexible tools have seduced others. Compare bank folks with others...

Difference betweeen software engineers and hardware engineers -- more like diff between scientists and engineers. The former are driven by the project (hacking -- trying to test out a new theory), the latter are driven by getting the project out the door. Andy's data about the two types, with SW eng's significantly less interested in "getting product out the door".

I'll claim that the job is NOT to get the product out the door in software -- it's more of an on-going service with users modifying and manufacturers examining it.

Tools that support user productivity must take into account the dynamic interaction between an individual user and the information and how the value of the information changes over time. (rather than just the content of the information.)

Networks of electronic mail and network news groups are an example of a *co-adaptive system*, in which the users change the system and the system changes the user. Other examples include:

spreadsheets, Management Information Systems, hypercard, Information Lens and certain types of educational software. Co-adaptive systems tend to reflect the organizations in which they are used and provide significant opportunities for user innovation, increased productivity and enhanced adaptibility to change.

From the perspective of an individual, the relationship between an individual item of information (electronic or otherwise) and the person changes over time. This means that tools designed to help users deal with information will be considered difficult or unsatisfactory if they cannot adapt to changes over time.

From the perspective of groups of users, the ways in which the people use the system has a lot to do with critical mass and ability to share information. Discovered that technical people develop "islands of expertise" -- akin to the gatekeeper concept, which develops over time. (Start out in an overload situation, with too many messages, too many dl's, don't know what's important. Over time, become interested in a few areas, learn who to ask when you need info about other things. Email as a pointer to local experts. Reduce info load, probably become known as an expert yourself, identifying certain areas and having other people forward things to you because they know you're interested. Some people are information junkies -- others are much more focused.)

Dynamic nature: how it affects individuals and the tools to support them. How it affects organizations and how the organization adapts to change. Talk about Zuboff's "informated" organizations -- when feedback about becomes an important characteristic.

What makes people innovate: provide feedback...

The value of a piece of information changes over time -- even if the content doesn't. This relates to educational software and electronic communication in general. It also says something about choice -- who's in control of the communication and the tools to control that communication.

In this thesis, I make a number of claims:

From the perspective of groups of users, the ways in which the people use the system has a lot to do with critical mass and ability to share information. Discovered that technical people develop "islands of expertise" -- akin to the gatekeeper concept, which develops over time. (Start out in an overload situation, with too many messages, too many dl's, don't know what's important. Over time, become interested in a few areas, learn who to ask when you need info about other things. Email as a pointer to local experts. Reduce info load, probably become known as an expert yourself, identifying certain areas and having other people forward things to you because they know you're interested. Some people are information junkies -- others are much more focused.)

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The unifying theme is the dynamic relationship between people and electronic information. I am interested both in understanding how people communicate in organizations and in improving the effectiveness of the tools that support that communication.

I have created several research groups over the past ten years and attacked the question from a number of angles. We have studied behavior in the field (e.g. studies of electronic mail use and how field service technicians work) and in the lab (e.g. experimental studies of electronic tutoring and educational software). This work has resulted in new research strategies (e.g. video prototyping and a matrix approach to the design of applications and systems) and the development of better tools for data collection and analysis (e.g. Argus data collection, the Experimental Video Annotator (EVA) and the generalized "Wizard of Oz"). This has lead to several theoretical models that have been implemented in the form of software (e.g. Argus, Pygmalion, Editor tutor, Navigation project, Interactive trouble-shooting simulator, etc.) and tested in the field (e.g. Lens and Argus studies).

An interesting aspect of electronic communication systems is that they appear to be "co-adaptive". The users of the system are both influenced by it and actively involved in changing it over time. Different organizations with the same software base may end up with qualitatively different patterns of behavior and software environments over time. Some systems seem to be naturally co-adaptive, yet current software development processes do not take this characteristic into account. I am interested in developing techniques for studying this phenomenon and in creating processes for developing and encouraging such systems. I believe they present a method of encouraging individual growth and fostering effective reactions to constantly changing environments.

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Dedication

Hal Abelson Murray Sidman Xerox PARC Jack McCredie Carl Klempner Deborah Tatar, Michelle Fineblum, Michael Granat, Bonnie Samet Mum, Dad, Trevor and especially Heather Steven Wertheim

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Chapter 1

Introduction

1.1 Introduction and fundamental assertions

Paragraph Paragraph

The person to cite is (Ackerman, 1988). The other person is (Balkovich, 1985).

Figure 1-1 below shows xyz. This appears on page 10.

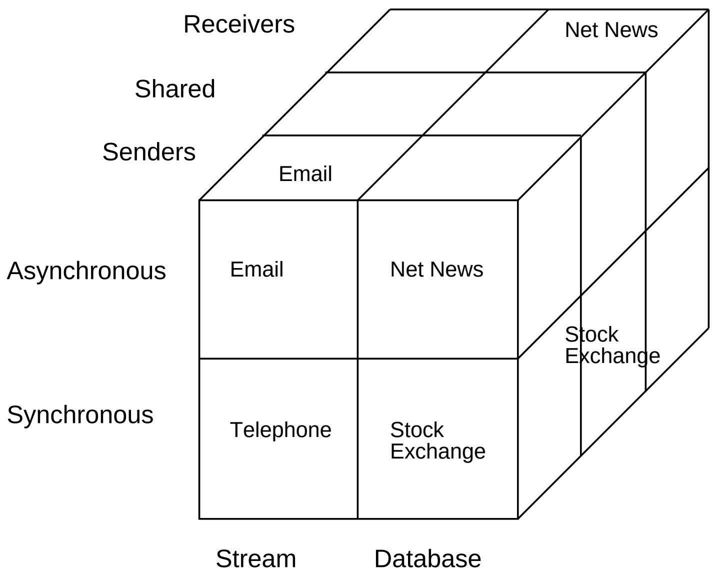

Figure 1-1: Some caption here

1.2 Research Issues

Paragraph Paragraph

Table 1-I below shows xyz. This appears on page 11.

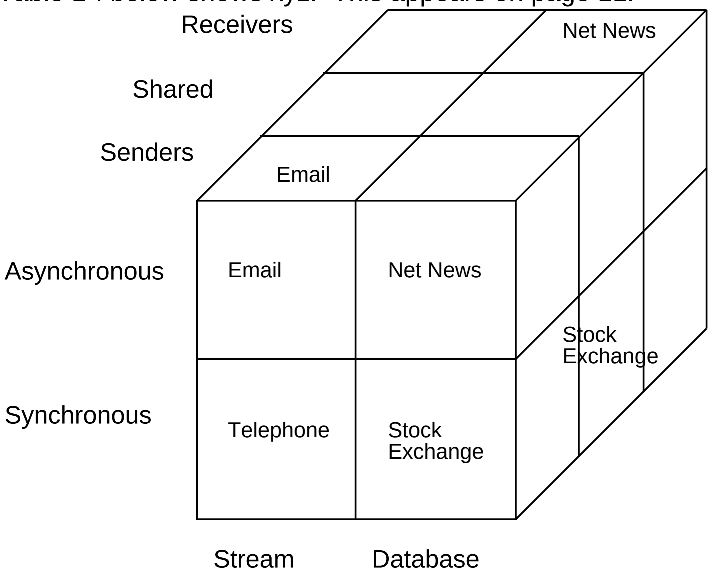

Table 1-I: Test table caption

1.3 Plan of this dissertation

Paragraph Paragraph

Refer to section 1.2 for more information about research issues.

Paragraph Paragraph

Talk about co-adaptive systems.

Talk about user feedback.

Chapter 2

Literature Review

2.1 Overview

2.2 Communication

2.3 User Interface

2.4 Management of Innovation

2.5 Summary

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Chapter 3

Results of Pilot Studies

3.1 Integrated Communication

3.2 Co-Adaptive Systems

3.3 Predictors of Innovation

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Chapter 4

Hypotheses and Theoretical Framework

4.1 Integrated Communication

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4.2 Co-Adaptive Systems

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Figure 4-1 above shows this. This appears on page 16.

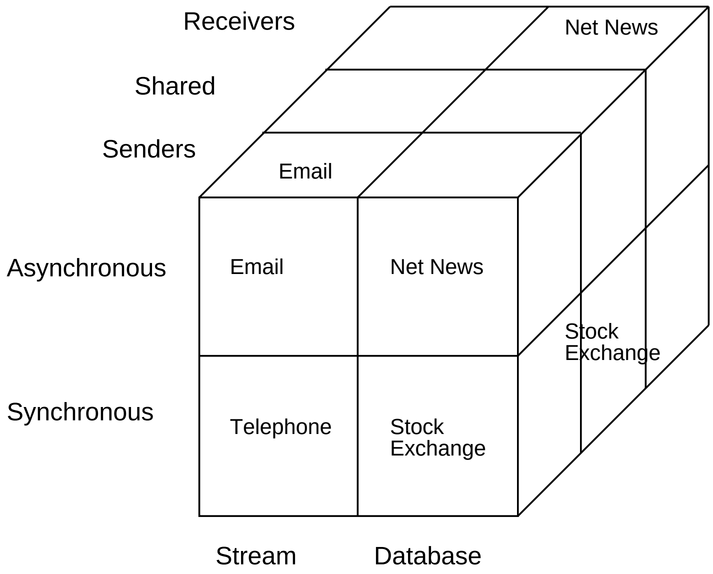

Figure 4-1: Some caption here

4.3 Predictors of Innovation

4.4 predictors

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Chapter 5

Research Procedure

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5.1 Research Philosophy

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5.2 Method

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5.2.1 Subjects

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5.2.2 Site

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5.2.3 Method

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Chapter 6

Results

6.1 Field Study 1

6.2 Field Study 2

6.3 xxx

6.4 yyy

Chapter 7

Design Implications

7.1 Software Architecture

Flexibility -- different kinds are possible. Choice of "settings" is different from programmability. Look at differences between spreadsheets, hypercard, etc.

7.2 Redefined Process

Most software development processes treat each piece of software as a fixed collection of features, which are added and subtracted based on various constraints. Another view is of providing a service to customers, with interim snapshots along the way, and sometimes quite distinct changes (Utterback's disconinuities).

Talk about how this changes the overall framework for the development process. Involves users in the development process even AFTER the product is shipped. How to provide the feedback loops?

7.3 The Role of Feedback

Chapter 8

Conclusions

8.1 Summary

8.2 Future Research

Appendix

This should be an appendix.

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