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**The Social Design of Worklife With Computers and Networks:
An Open Natural Systems Perspective**

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1.0 INTRODUCTION

If you read a broad sample of books or articles about computerization and changing work, you will find that groups of authors seem to be writing about completely different universes. Some focus on older technologies, or on current technologies; others explore the possibilities afforded by emerging technologies. A few writers will focus on those professionals who have significant influence over the organization of their activities and the technologies they use. Other writers focus on workers who have little discretion to control their work content, schedules, processes, or uses of technology. Analysts may examine managerial practices exclusively, or write as if technology itself creates new forms of work. There are a plethora of conflicting portraits of computerization and work -- from technologies that enhance flexibility and collaboration in groups to technologies which tighten domination.

Certain computer technologies have important potentials for changing the basic concept of work. Writers differ in their opinions as to which technologies are most likely to catalyze major changes. Some hold that special technologies, such as personal computers (PCs), networking, groupware, notebook computers with cellular modems, or "personal digital assistants" will create more flexible and interesting work. Others emphasize special forms of interfaces, such as windows, pens or voice recognition. Analysts also differ in their arguments that a wide variety of computer systems can be used to restructure work to either improve or degrade its quality.

This chapter examines how work with computer-based and networked systems can be organized to affect the quality of working life for clerical workers, administrative staff, professionals, and managers. A key theme and key contribution of this chapter is our analysis of specific major assumptions regarding how organizations behave -- assumptions that undergird many books and articles about computerization and worklife.

Much of the research and professional literature about worklife in computerized and networked workplaces is based on a tacit assumption that organizations behave as Rational Systems. Rational Systems models emphasize formal goals, actions to achieve them, and their costs and benefits. They also tend to portray workers or managers as sharing common goals. Closed Rational Systems models focus on the rationality of organizational behavior by focusing on the participants' focus on goals and actions that are defined *within* a particular organizational system, such as a workgroup or organization. These models help answer questions about how computerized systems can alter idealized organizational efficiencies. But they do not provide comprehensive concepts for effectively answering questions about when people, groups and organizations will adopt specific computer and network systems, how they will use them, and what the key consequences of usage are.

A richer understanding of workplaces can be gained by relaxing the assumptions that organizations are primarily rational and closed systems. In this chapter we will examine alternative assumptions. Organizations can be viewed as *open systems* when participants are influenced by the social relationships they have outside their immediate workplace or organization. We will also examine organizations as *natural systems* in which participants are concerned with preserving their autonomy and the longevity of their social unit rather than simply efficiently solving work problems regardless of its consequences for them and their colleagues.

The Open Natural systems perspective can influence the "social design" of work with computerized systems, especially when those workplaces are connected by electronic networks. New computing and communications technologies increase organizational options but do not uniquely determine them. Organizational practices can shape computerization strategies as much or more than the technologies shape the organization. We illustrate and contrast the implications of natural systems and rational systems assumptions for researchers and practitioners by discussing new forms of work organization, control and coordination of work, and by the integration of computing and networks into worklife.

One of our key concerns is to find ways to effectively conceptualize the relationship between new forms of computerization and changing work. Every few years systems developers and vendors champion new computer technologies which they characterize as "revolutionizing the ways that people work." In the early 1980s, online integrated database systems were heralded as the harbingers of new forms of work. Soon, PCs and expert systems followed as the key media of transformed (and improved) worklife¹. In the early 1990s, groupware and networked systems have become the technological heroes for transforming worklife. During the next few years, we expect to see similar claims for multimedia, tiny computers ("personal digital assistants") and other emerging technologies. Advocates of emerging technologies including computer scientists, technical journalists, and consultants, often characterize them as being "so fundamentally different" from their precursors that one cannot learn from previous experiences of computerization to understand some of their important uses, roles and consequences². While this position seems to recommend appropriate humility in making strong predictions, it also serves the political role of distancing a new technology from discussions about the problems that plagued some earlier information processing technologies.

We do not explicitly examine the cavalcade of hype and hope that accompanied the introduction of each of these technologies. Many of these technologies help managers and professionals effectively reorganize worklife. But they are less important than stories in professional magazines and the popular press suggest. Their effects are often diverse because they depend upon important contextual influences. This chapter examines some key assumptions about people, work, organizations and the roles of technologies that help us better understand the likely roles and consequences of emerging technologies.

¹ See George and Tynan (in press) for an interesting effort to examine the workplace consequences of expert systems. While there has been limited empirical research about the consequences of expert systems on work, there is a large body of research about other computer technologies. They carefully examine parallels between expert systems and other computer systems to argue "that most of the predictions made about them are unfounded."

² See, for example, Daniel Hillis comments about emerging technologies such as virtual reality and massively parallel computing architectures:
"Whatever you imagine virtual worlds will be like or whatever I imagine, is likely to be wrong. Profound change is inherently hard to think about. What is certainly true is that the future is not just a simple extrapolation of what we know today. Massively parallel computing transforms both the economics and the absolute capabilities of information processing. All that can be said for certain is that this is bound to cause changes, and that change is difficult to think about. I am confident that once again, reality will go beyond our imagination." (Hillis, 1992: 14).

2.0 THE IMPORTANCE OF WORK

A tacit theme in most analyses of computerization and worklife is that the quality and character of working life is an important aspect of social life. But the relevance of work quality as a major topic in the information systems field is not universally accepted. Many writers focus on the economic effects of computerization and ignore the quality of working life (e.g., Cash, McFarland, McKenney, and Applegate, 1992). We do not share this economic view. The following are key reasons why we believe the quality of worklife should be a central topic in discussions of computerization.

First, wage earning is a major component of many people's lives. Wage income is how most people between the ages of 22 and 65 obtain money for food, housing, clothing, transportation, etc. The United States' population is approximately 250,000,000, and well over 100,000,000 work for a living. Fundamental changes in the nature of work -- the number of types of jobs, job content, career opportunities, social relations and working conditions of various kinds -- affects a significant segment of society.

Second, in the United States, most wage earners work 30 - 60 hours per week -- a large fraction of their waking lives. People's work experiences shape other aspects of their lives as well. Work pressures or pleasures can be carried home to families. Better jobs give people room to grow when they seek more responsible, or complex positions, while stifled careers often breed boredom and resentment in comparably motivated people. Although people vary considerably in the kinds of experiences and opportunities they want from a job, few people would be satisfied with a well paid, but monotonous, and socially isolated job.

Third, many of the arguments advanced for the economic value of new forms of computer technologies make strong tacit assumptions about how people will work with them. Understanding the relationship between computer use and organizational productivity is paramount. It is crucial to know what people's work practices and (dis)satisfactions actually are. In the late 1980s, an array of PC-based applications commonly referred to as "productivity tools" were introduced. Most of the evidence regarding the use and value of the applications tends to be anecdotal (e.g., Baily, 1991; Salerno, 1991). No extensive fine grained studies assess how this family of applications altered the productivity of the people who use them. Computer systems are regarded as expedient as shifts akin to switching from manual to power tools. The assumption is that gains in speed and effectiveness will readily accrue to most people who use these systems. However the productivity among North American office workers during a period of intense computerization in the 1980's resulted in a period of slow growth (Dunlop and Kling, 1991 Section 2; Baily & Schultze, 1990). Productivity calculations account for the costs of buying and using technologies as well as the improvements which they offer. Our own observations in organizations suggest that organizations differ significantly in the extent to which they adequately train people to use computer systems, in the extent to which they encourage innovation from clerks as well as professionals, and in the extent to which the organizations learn to effectively use computing (Jewett and Kling, 1990).

Fourth, computerization has had a visible direct effect on more people in their workplaces than in any other setting: home, school, church, etc. Workplaces are good places to examine how the dreams and dilemmas of computerization operate for millions of people under a variety of social and technical conditions.

One aspect of worklife that may remain problematic for analysts is the immense variety of workplaces that exist. Some researchers (cf., Bullen and Bennett 1991; Sproull and Kiesler 1991a; Lepore, Kling, Iacono, and George, 1989) include organizations of diverse sizes and task orientations in their studies.

But it is always an inductive leap to generalize one's findings over a wide range of clerical, technical, professional, and managerial activities or over a wide range of manufacturing and service industries.

3.0 RATIONAL AND NATURAL SYSTEMS MODELS OF ORGANIZATIONAL BEHAVIOR

Many of our ideas about the function and value of computerized systems in organizations -- including computerized communication systems -- are strongly influenced by our conceptions of how organizations behave. It is common for many advocates and analysts of new computing and networking technologies to portray organizations as streamlined task systems. In this portrait, organizations are relatively "well oiled machines" in which jobs and worklife are well-defined. These computerized systems improve efficiencies and expand peoples' methods of efficiency. With the organization-as-machine as a background metaphor, analysts can conceptually "plug in" new families of computing and networking technologies and identify possible improvements or degradations in how people work and the ways in which organizations behave. For example, one can talk about using electronic mail (email) or telecommuting facilities to enable people to communicate more effectively while working in different places and at different times. Some go so far as to say that electronic communications "shrink time and space to zero."

The machine metaphor a one common image of organizational behavior and helps highlight the possible advantages of new computational and networking systems. But there are other important metaphors about organizational behavior. At various times we also speak of organizations as cumbersome bureaucracies or political war-zones. Specific organizations (or departments) have reputations as being "boiler rooms" where managers force their staffs to work hard day in and day out, while others are spoken of as "country clubs" in their ethos. There are unlikely to be many similarities of methodology in computing among "boiler rooms" and "country clubs." It is equally unlikely that computerized communication systems will be used in identical ways and with similar consequences in organizations which are primarily streamlined task systems, bureaucracies or war zones. Unfortunately, relatively few studies of computerization and worklife identify key assumptions about how organizations behave outside of the workplace under study. One key advance in this chapter is to link an understanding of computerization, work, and networking to patterns of organizational behavior which extend beyond the local workplace and workgroup.

Before we begin discussing computerization, work and networks in substance, we will introduce a simple conceptual vocabulary for discussing organizational behavior. The main problem in

relying upon vivid metaphors of organizations such as machines, bureaucracies or war-zones is that they homogenize behavior within organizations. When a bank is labelled as bureaucratic because of its rigid rules in granting credit, the image of "bank as bureaucracy" paints all of the bank's behavior as similarly rule bound. It helps to have a more differentiated methodology of examining behavior in and between organizations.

3.1 Rational Systems Models of Organizational Behavior

There are numerous models illustrating how organizations behave. Scott (1987) introduced a very helpful scheme for clustering many of these models along two key dimensions: Open Systems -Closed Systems and Rational Systems-Natural Systems (Tables #1, #2, #3).

Rational Systems	Natural Systems
Collectivities oriented toward the pursuit of relatively specific goals and exhibiting highly formalized social structures.	Collectivities whose participants share a common interest in the survival of the system and who engage in collective activities to secure this end.

TABLE 1: RATIONAL AND NATURAL SYSTEMS MODELS OF ORGANIZATIONAL BEHAVIOR (from Scott, 1987:22-23)

In information systems development and use, computerization and worklife, and work with computer networks literature, "rational systems" models are common, and often tacit. The Rational Systems Model views organizations as instruments for specific purposes, and the most important organizational behaviors are various ways of achieving those purposes. Analysts who rely on Rational Systems Models often emphasize questions of efficiency. For example, they may ask whether CAD systems can effectively reduce the design time for a new product and whether electronic mail can efficiently substitute for face to face meetings and reduce travel costs.

When the answers to these questions focus on influences which are wholly contained within the organizational unit under study, then the model is also a Closed System model. For example, a Closed Rational analysis of a CAD system could focus on the speed, labor costs, and skills for creating designs and revising or reusing existing designs with different CAD systems (or manually). However, other answers to the same set of questions might focus on relationships between the groups that use CAD and groups that are *outside* of their organization. For example, one CAD system may make it easier to exchange design data with a major customer while another otherwise similar CAD package may accept more industry standard formats and thus help the designers work efficiently with more new customers. These relationships between customers in one set of organizations and people who use CAD in another organization are part of an open-systems analysis (Table #2).

Closed Systems	Open Systems
All key influences on organizational behavior come from within the identified organization	Some key influences on organizational behavior come from outside the identified organization -- through relationships with clients, suppliers, other institutions such as schools, regulatory bodies, professional associations, etc.

TABLE 2: CLOSED VERSUS OPEN SYSTEMS MODELS OF ORGANIZATIONS

The best known Open Rational Systems models of organization-level behavior are the "contingency models" which hold that the best way to organize depends upon key features of an organization's "environment." Contingency analysts would argue that organizations which are making products and delivering services in relatively stable environments can be most effectively organized with highly refined systems of rules and sharp divisions of labor. In contrast, organizations which have dynamic markets for their products and services are most effective when they are organized in less bureaucratic ways. In practice, organizations may mix their level of bureaucratization. This line of theorizing helps explain why universities may have highly centralized control over new courses and curricula (through faculty committees) while having relatively high levels of decentralization in opening up new lines of research when they are initiated by individual faculty.

	Closed Systems	Open Systems
Rational Systems	Unified task systems in which upper managers guide subordinates towards clear goals through explicit strategies ³ .	Unified task systems in which upper managers guide subordinates towards goals which can be uncertain and shifting, and with means that are influenced by relationships with groups outside the focal organization.
Natural Systems	Coalitions of shifting interest groups that develop goals by negotiation; the structure of the coalition, its activities and its outcomes are primarily influenced by tasks, technologies and relationships between participants <i>within</i> the focal organization.	Coalitions of shifting interest groups that develop goals by negotiation; the structure of the coalition, its activities and its outcomes are strongly influenced by tasks, technologies and relationships with institutions, groups and people <i>outside</i> the focal organization.

TABLE 3: FOUR MAJOR TYPES OF MODELS OF ORGANIZATIONAL BEHAVIOR⁴

Closed Rational System models do not provide strong concepts for understanding ambiguity in the kinds of problems facing organizational participants, their goals, lines of action, available means, value of specific technologies, the best ways of organizing work, etc⁵. The Closed Rational Systems models are often used to help answer questions about the efficiency and effectiveness of organizational methods, the value of new technologies, etc. Many research studies of electronic communications focus on these kinds of questions⁶, including:

- 1) What is the effect of electronic media on communication efficiency, participation, and interpersonal behavior?
- 2) Which features are most important to people who use specific computer systems?
- 3) How can a communication medium be selected to most effectively match the communication task?

Closed Rational systems model the men and women who use computers as selecting equipment which is most suitable for their current tasks and using it efficiently for those tasks. Open Rational systems models examine how people and organizations select and use computing equipment in ways that are influenced by social relationships which extend outside their focal organization as well as by technical requirements which are shaped by their tasks and social relationships within their home organizations. For example, a Closed Rational systems analysis cannot account for the possibility that people often want to use computer systems which can help them qualify for better jobs in another organization. In contrast, Open systems models can

³ For a more extensive discussion of specific rational and naturalistic organizational models, see Kling (1992).

⁴ This conceptualization is influenced by Scott (1987:20-25).

⁵ Charles Perrow has written eloquently about the way in which these accounts reflect a managerial ideology which attributes exceptional insight, foresight and power to managers (Perrow, 1986).

⁶ Recent reviews of the literature have been published by Heintz (1992), Lewenstein (1992) and Rice (1992a).

accommodate such relationships (ie, possible future employers) who are located outside of the person's home organization. Similarly, an Open Rational systems analysis of electronic mail use would ask what sorts of social relationships outside of the focal organization influence a person's interest in using electronic communication and activities that she uses it for. An engineer may argue that she needs access to the Internet in order to track professional events on comp.software-engineering, but may actually find other bulletin boards which focus on recreation (rec.*) even more interesting and time-consuming. The Open Rational systems models have rarely been applied in research studies of computerization and work with networks⁷. But we shall indicate their power in subsequent sections.

Professionals and managers try to understand the economic dimensions of computing and networks. However, the reliance on Closed Rational systems models of economic and organizational behavior leaves out important aspects of worklife with computing that practitioners should not ignore when they seek reliable analyses.

3.2 Natural Systems Models of Organizational Behavior

Natural Systems models are one major alternative to rational systems models of organizations (Tables #1, #3)⁸. There is an interesting body of sociological research which shows that organizational members often develop new purposes to keep an organization going, even when original goals were met or at least resolved. Many of the key members may have a stake in keeping the organization stable or growing. The label "natural systems" refers to the interests of organizational members in keeping their organization alive -- like an organism in nature.

An interesting example of organizational activity which fits a Natural systems model is found the efforts of some centralized information systems (IS) departments to take control over as much desktop computing as they can even though many professionals and managers prefer to have local control over their systems. In the late 1980s, the upper managers of these IS departments saw their client base and their staffs shrinking, and fought to retain control over computing services in their organizations. From the viewpoint of Rational Systems models, centralized IS departments would be retained only to the extent that they could provide services more efficiently and effectively than decentralized alternatives. Moreover, their managers would also seek to organize their activities primarily in ways that would be "best" for their organizations, rather than best for the IS staff (in terms such as job security, status, pay, and influence). Natural systems theorists would predict that many IS managers would try to find ways to maintain a role for their departments even when some of these roles would advantage IS at the expense of their clients. Their efforts, in altering their mix of services and in exercising whatever political influence they could muster, would play a significant role in influencing the extent to which organizations would maintain centralized IS departments.

⁷ For example, Pickering and King (1992) argue that organizations which pay for internet services for their staff are overspending. They claim that the primary value that men and women get from the Internet is in maintaining weak ties with colleagues in other organizations -- which facilitates job hopping. These benefits don't accrue back to the organization that pays their bills for using the Internet.

⁸ Natural systems models are not the only alternative to Rational systems models. See, for example Burrell and Morgan (1987).

We can view organizations as Closed Natural Systems or as Open Natural Systems (Table #3). In Closed Natural Systems models, organizations are not as influenced by the social relationships which extend outside of their boundaries. We model an organization by drawing a boundary and treating the elements within that boundary as a coherent social unit oriented toward the pursuit of specific goals. If we identify the key organizational system as a particular business firm, then the efforts of its IS department to control the standards for all PC and LANs would be a closed natural system analysis. On the other hand, some computer scientists' preference for Unix systems and related software is based on a consensus about "good computing equipment" in academic computer science, rather than on a selection of the most efficient equipment to carry out their work. If the focal unit is a specific computer science department, then this observation illustrates an Open Natural Systems analysis.

Researchers have begun to examine computerization and work from the viewpoint of Open Natural Systems models (Kling and Iacono, 1984; Bullen and Bennett, 1991). They have also begun to examine electronic communications from this perspective. Key questions that researchers have addressed recently include:

- 1) How much are the perceived effects of electronic communications attributes of the media, and how much do they depend on the social relations that participants have with groups that extend outside their immediate workplaces?
- 2) How can we understand the way that electronic communication can undermine face-to-face relations in work groups?
- 3) How do different uses of computer-communications technology affect informal group processes in organizations?

Sociological theories of organizations started with Closed Rational Systems models (represented by Max Weber's model of bureaucracy and Frederick W. Taylor's analysis of scientific management) earlier in this century (Table #4). In the 1930s, they expanded to include Closed Natural Systems models (the human relations school). Open Rational Systems Models (bounded rationality, contingency theory) were developed in the 1950s and 1960s, along with Open Natural Systems models (ie, negotiated order and institutional theories). Table 4 identifies some of the major theories within each of these four types. Social analysts of computerization frequently adopt similar perspectives to those of organizational theorists⁹. In this chapter, we will examine how the assumptions about organizations as reflected in these four broad families of models influences our understanding of work with computing and networks. The particular theories in each of these four categories differ in some key ways, such as their levels of analysis and key organizing concepts. But they share important assumptions whose implications we will explore below.

⁹ Kling (1980) grouped these studies into two broad categories of systems rationalism and segmented institutionalism.

	Closed Systems	Open Systems
Rational Systems	Scientific Management (Taylor) Decision-Making (Simon) Bureaucratic Theory (Weber)	Bounded Rationality (March & Simon) Contingency Theory (Lawrence & Lorsch)
Natural Systems	Human Relations (Roy, White, Mayo, Dalton)	Negotiated Order (Strauss) Socio-Technical Systems (Miller & Rice) Strategic Contingencies (Hickson, Child) Resource Dependence (Pfeffer & Salancik) Institutional Theory (Selznick, Dimaggio & Powell) Social Rule System Theory (Burns and Flam)

TABLE 4: EXAMPLE THEORIES OF ORGANIZATIONAL BEHAVIOR¹⁰

The Rational System models remain influential in many practical discussions within organizations about adopting computer technology. Much of the justification given in organizations for new system purchases remains focused on tasks, equipment capabilities and costs: electronic mail, for example, may be championed because its cost per message is seen as lower than normal postal service and will provide almost-instantaneous delivery.

In contrast, Natural Systems models allows us to examine very different aspects of computerized systems. They allows professionals and managers to look beyond the "sales hype" that inevitably accompanies new technology by questioning simple cause-and-effect relationships between computer systems and work performance (i.e., technological determinism). The view from this perspective provides a broader picture of the system and its setting: hardware, software, institutions, unwritten assumptions and traditions, organizational politics -- and the strengths, weaknesses, biases, personal agendas, and unpredictability of participating groups and individuals. Natural System models encourage us to examine the behavior of the organizations themselves as systems with rich political orders where important practices and structures may be institutionalized and inflexible.

4.0 SOCIAL DESIGN OF COMPUTERIZED SYSTEMS AND WORK SETTINGS

An exciting recent development is the effort by some researchers and practitioners to conceptualize the design of computer and networked systems as a set of interrelated decisions about technology and the organization of work. Managers and professionals who focus on the

¹⁰ Adapted from Table 5-1 of Scott (1992).

use of computing may find that this approach fits their routine practices. But thinking and talking about computerization as the development of socio-technical configurations rather than as simply installing and using a new technology is not commonplace.

Many professionals use computer technologies which expand the range of their work methods. The adoption of electronic mail to facilitate communication between people who work in different time zones and the acquisition of compact portable computers to facilitate working on the road are two routine illustrations. But organizations that adopt portable computers and email to improve the flexibility of people's work relationships must do more than simply acquire technologies to realize these specific advantages. For example, portable computers may help people work outside of their offices. Some of the resulting convenience hinges on technological choices, such as acquiring machines which run software whose files are compatible with file formats used in the office. But much of the resulting flexibility depends upon social choices as well. For example, if organization A requires men and women to report to work daily during regular working hours even when they have the portable computers, then people gain relatively little flexibility in work location if that policy is not also changed. People may be able to take portable computers home after hours or on weekends, or on the road while they travel. Thus, organization A may gain some unpaid overtime work with these policies. But the men and women who work in organization A will not gain much of the "control over the location of work" which people many attribute to portable computing. In contrast, if organization B allows its employees to work at places and times which they choose, then its employees can use portable computing to have even more flexibility in their work. In each of these cases, the men and women who adopt the equipment and construct work policies and practices for organizations A and B have created distinct socio-technical configurations -- or social designs. And these social designs which incorporate portable computing, rather than the technology alone, have different consequences.

In a similar way, organizations develop specific socio-technical configurations, or social designs, around electronic mail. Few organizations adopt the social design of "universal and unlimited" electronic mail access in one rapid move. Most organizations diffuse electronic mail in which some people obtain access and services more readily than others. Tacit policies about granting access to email varies from one organization to another. For example, Organization A may give email access to everyone in particular departments, while Organization B may grant mail accounts only to employees who request them. Organizations also differ in the way that their managers construct policies related to computer communication, such as the extent to which they regulate disk space for storing mail, regulate the topics about which employees can set up computer conferences, and allow managers to monitor their subordinates email. Any collection of these kinds of policies and practices, specific email systems and their technical capabilities, and the resources to support the technology's use, form specific social designs.

The effective diffusion of mail services often takes many years in larger organizations which employ thousands of people. Even though managers may approve major equipment purchases and construct many key policies pertinent to email, many practices evolve over time. Markus and Robey (1988) explain that computerization is often an "emergent process" whose character develops over long periods of time.

ARENA	Social Design Choices to Adopt, Create or Restructure:
Technology	Selection and configuration of hardware and software.
Social Organization of Work	a. The division of labor. b. Rewards/demands for learning new systems. c. Access to machines and data.
Equipment Access	a. Shared vs. independent systems b. Who has access and with what privileges c. Standardization of systems and capabilities d. Extensiveness of use within a work group or organization
Infrastructure	a. Training programs b. Availability of Adjunct Resources (e.g., space)
Control Patterns	a. Implementation strategy and operations b. Daily working conditions c. Levels of monitoring

TABLE 5: SOME ELEMENTS OF A SOCIAL DESIGN

Analytical research about computerization in organizations, as well as our own systematic observations, has helped us identify many arenas in which organizational participants make *social choices* about the socio-technical configurations of their computerized and networked systems (Jewett and Kling, 1990; Jewett and Kling, 1991; Kling, 1992; Bikson & Law, 1993; Markus, 1994). We use the term "social design of computerized systems," or "social design," to characterize the joint design of both the technological characteristics of a computerized systems and the social arrangements under which it will be used (Kling, 1987A). Table #5 lists several common social dimensions which can be part of the social design of a computing or network system¹¹.

The ways in which these broad arenas are organized through explicit policies and routine practices create a structure for the opportunities and constraints of computer and network use within any organization. These "social choices" are a necessary element of computerization, even though they are usually not formally decided or completely within the control of any one actor. They can even be byproducts of oversight, such as managers who neglect to train their staffs in a new computing application because they assume that it's "just like the old one" or "very user friendly." In any organization with more than a few dozen participants, these arenas are likely to be under the control of different actors. But these "choices" can enable or hinder the actual role of new technologies in changing work. Consequently, system developers and managers can support or subvert the possible advantages of "better technologies" through their social designs, even when they are implicit.

The social consequences of computerization or network use are dependent on the choices in these arenas, as well as other similar ones. The particular collection of social design choices can vary

¹¹ We have abstracted these dimensions from research studies about the use and impacts of computerized systems on people's worklives.

from one organization to another, and even often within organizations. When managers and professionals adopt or enhance a new computerized system, they may be able to alter some of these practices (and policies).

The social design of work systems with computing does not necessarily improve the quality of peoples' work lives. For example, some managers have computerized relatively routinized clerical work by fragmenting jobs and tightening supervisors' abilities to monitor the quality, pace and speed of people's work. These same managers may develop good systematic training programs for the clerks whose work is now more regimented. However, social design can also be very benign. It encourages participants in a computerization project to review the web of practices and policies related to computing which can otherwise be "unanticipated."

Figure #1 (below) shows a message that Rob Kling received from a top administrator in his university. His message announced that a new electronic distribution system "will allow us to significantly reduce paper use and costs associated with printing and delivering distributions ... (since)... individuals with on-line access to E-Mail will now receive most distributions electronically." From the announcement, it appears that much of his staff's attention focussed how to reduce the costs of distributing memos, with less attention being paid on how people who receive memos might have to reorganize their work and enhance their capabilities for storing, filing archiving, or printing memos.

UC Irvine's faculty, staff, and students use several different mail systems, and sending files across them is not always seamless. The person who wants to reliably manage memos that flow between these diverse mail systems need more sophisticated skills (or staff support) than do those people who communicate primarily within only one of these systems. The assumptions that seem to shape the Vice Chancellor's conception of a memo system focuses upon the distributors and their resources. His email message does not ask whether the faculty, staff and students who receive electronic memos have an adequate infrastructure for supporting their management.

The Vice Chancellor may view his proposed distribution system as simply exploiting existing computing resources. However it is an **implicit social design** because it reshapes work with computing. The collection of email networks at UCI is not a single artifact. Its technical architecture includes several mail systems and gateways, dozens of computers which run several operating systems, thousands of diverse microcomputers and workstations, and numerous diverse printers. Technical support comes from several different organizational locations. Control of technical resources such as disk space and printers often lies outside the immediate administrative domain of faculty, staff or students.

The overall system, including administrative controls for authenticating distributions at one end, and for assuring trustworthy receipt and management, is itself a complex socio-technical organization. And the "memo management systems" would be intricately woven into a rich web of social relationships which couple administrative authority, rules for obedience to the directives of some memos, the allocation of computing resources, and numerous new practices (Kling, 1987, Kling, 1992).

Most **explicit social design** approaches would have lead analysts in this situation to examine the process and organization of work for producing, distributing, receiving, reading and managing memos rather than focussing primarily upon one stage. However, different approaches to social design would conceptualize the key elements of that design very differently.

From: Mail and Records Services <mailsvc@orion.oac.UCI.EDU>
Subject: USE OF E-MAIL FOR INTERNAL COMMUNICATION
Date: Tue, 13 Oct 92 16:58:01 -0700
To: ALL EMPLOYEES: ;

October 12, 1992
RE: Use of E-Mail for Internal Communication

Mail and Records Services has developed a new "master distribution" system with the help of Academic Computing and Network and Telecommunications. This system will allow us to significantly reduce paper use and costs associated with printing and delivering distributions. Individuals with on-line access to E-Mail will now receive most distributions electronically. Those without on-line access will continue to receive paper copies.

Please coordinate all future distributions with Mail and Records Services prior to printing. Mail Services Manager Penny White will contact departments with procedures for this new program.

Thank you for your cooperation and support.

[name was included in original]
Vice Chancellor
Administrative and Business Services

FIGURE 1: ANNOUNCING AN ELECTRONIC MEMO DISTRIBUTION SYSTEM

Two of the major approaches to social design contrast strongly in their assumptions about people, organizations, technology and work. *Business Process Reengineering* is usually applied by managers and consultants to streamline operations (Hammer, 1990; Hammer and Champy, 1993; Davenport, 1993). The main aims of these reengineering projects seem to be reducing the time for a specific business process, such as dispatching a repairman to a site or processing an insurance claim, and also reducing the number of people who work on that activity. However, some consultants have promised more diverse financial benefits to their clients (and potential clients).

David Schnitt (1993) characterizes a business process in these terms:

A business process is best defined as an activity in the organization fundamental to operating the business that serves an internal or external customer and has a well-defined outcome or series of

outcomes. Every organization is made up of business processes. Examples include such mundane activities as accounts payable, inventory control, field service, or the processing of a customer application (such as in a bank or insurance company), but also includes less "back office" and more "front-office" processes such as new product development and budgeting. Since many work steps in business processes are executed by people in different departments, this view encourages a cross-functional perspective....the business process view of the Accounts Payable (A/P) process sheds new light on it as a complicated, slow, error-prone process involving many different departments and personnel. It reveals that the process is really the procurement process, not just A/P. Seen from this perspective, the opportunities for improvement are much greater. The key is to focus on the value-added outcome of the process (why it is done, not what is done) and how it relates to other processes in the organization. (Schnitt, 1993)

Michael Thomas (1993) describes business process reengineering in these terms:

The central message of reengineering is that business processes are generally built around paper, a technology with drawbacks that are obvious in a business environment. Technologies such as electronic imaging allow information to be located and communicated instantaneously, to be viewed simultaneously, to be acted upon in real time, often with the customer right on the phone. Blessed with such power, organizations can cast off procedures that are geared toward paper, often with dramatic results.

Business process reengineering brings an industrial engineering perspective to the design of organizations and work. The flow of documents and authorizations are key elements, and the character of people's jobs is a secondary consideration in much of the writing about this approach to redesigning organizations. Computer systems of various kinds are often key elements of a re-engineering project, including scanners and document processing systems at the "front end" of a process, and the use of workflow software to model and manage some of the subsequent activity.

The analyses which support these projects usually rest on Rational systems models of organizations. They can be Open Rational systems models when they examine workflows that run across departments. But they are usually closed off at organizational boundaries, except to view services from the viewpoint of customers/clients. They usually examine few influences on worklife and work organization other than those that directly pertain to reliable and efficient workflows.

The major alternative approach, sometimes called socio-technical systems design, makes people and their relationships in support of work, rather than workflows, the center of organizational reforms with information technology (Johnson & Rice, 1987; Zuboff, 1988; Pava, 1983). Peter Keen (1991) articulates this approach in these terms:

The business team, rather than the functionally defined hierarchy or the dotted-line or matrix-management variants that show up on the organization chart, is increasingly being seen as the real unit of organizing. Business is finally recognizing that division of labor is increasingly ineffective as the basis for an organization in an environment of constant rather than occasional change and of shifting functions to the proven project and team-based processes long employed by the research and technical functions. Teamwork is relational; the quality of performance rests on the quality of interactions, communication, and coordination among team members.

Information technology affords the opportunity to build what might be termed the "relational" organization: an organization defined not by fixed structures but by ease of relationships. Instead of focusing on organization structure, business today needs to look at the mechanisms that make communication simple, flexible...IT makes practical many of the visions of management thinkers. The management principles for exploiting IT organizational advantage require a basic rethinking of old assumptions--especially concerning the links between strategy and structure--at the top of the firm.

Flexibility and adaptability are the new watchwords for organizations and for people. Firms that do not attend to their people's careers as well as their jobs might well have to replace much of their work force. Their human capital will be a depreciated resource, one they may find harder to replenish than they thought (Keen 1991).

Keen's analysis appeals to many professionals. One technologically oriented corollary leads some computer scientists to develop designs for computer systems which facilitate communication and collaboration in diverse forms: mail systems, conferencing systems, co-authoring systems, and so on (Kling, 1991b). But it is much too facile to think that lower status workers, such as clerks and semi-professionals are most appropriately targeted with business process reengineering while only higher status workers, such as managers and professionals, can bask in a more supportive and enriched relational organization.

For example, Jim Euchner and Patricia Sachs (1993) recently reported about the redesign of a "work system" in which a regional U.S. phone company (NYNEX) provided customers with high speed (T.1) phone service. The installation required the collaboration of over 40 people in 5 distinct departments (Corcoran, 1992). NYNEX took much longer to complete these installations than their competitors, and rapidly lost significant market share in New York City. A computerized scheduling system had been used to assign different technicians to their specialized activities in the installation and fine-tuning of the T.1 lines in customers' offices. A large part of the delay seemed to derive from the way that some key problems cut across the domains of different technicians -- they were either problems at system interfaces, or problems whose causes were somewhat ambiguous. The computer system helped to efficiently schedule the technicians' trips to the site -- one at a time -- to give them full and balanced workloads. It did not help bring together the specific technicians who would be needed to solve the more vexing installation problems.

A group from NYNEX's Science and Technology Center collaborated in a socio-technical design with both the craft workers and managers who were responsible for T.1 installations to develop a new "work system design." Some of the principles of work system design that they articulated are common themes in many socio-technical systems projects. For example, they had craft workers who do the actual work, as well as more senior managers, design the new work system and implement it. They focussed on workflows and whole processes rather than upon discrete tasks, a concept which is shared with many business process reengineering projects. However, they sought to provide people with ownership and responsibility for whole jobs, rather than discrete tasks. And they developed some specific guidelines for designing computer and communication systems: to support workflows and communications; to provide "intelligent"

information handling; and to have interfaces that match the language in which people conceptualize their work.

The new T.1 work system reorganized the installations around cross-functional teams who have joint responsibility for insuring that installations are prompt and effective. The team's composition is rather fluid and can depend upon the specific customer and the stage of the installation. But they usually mix both white collar and blue collar workers, and can include people at different managerial levels. The coordination relies upon people scheduling technicians rather than upon computerized scheduling, although computer support is provided for other activities. In this particular case, the work system was redesigned, while the existing computer systems were left untouched.

Jewett and Kling (1990) report the case of a pharmaceutical firm in which sales managers radically restructured the responsibilities of sales clerks from passive order-takers to be more proactive sales representatives. The department held extensive meetings to reconceptualize their roles, and the staff rewrote all of the job descriptions. The resulting jobs were enriched and also reclassified at somewhat higher pay levels. The department's managers also commissioned the development of a new computerized information system to provide richer searching capabilities to support the restructured jobs. In this case, the configuration of the information systems was part of a larger social design which included the explicit reconceptualization of key jobs. (Also see Chapter 4 of Levering, 1988.)

These socio-technical strategies require that systems analysts and designers understand many of the work practices, schedules, resource constraints, and other contingencies of the people who will use the new computerized systems. Some organizations, such as NYNEX, have included social scientists on their design teams to facilitate such observation and understanding. They also recommend that people who use the systems have a substantial role in specifying their designs as well as altered work practices. One reason that stand-alone microcomputers may have been so attractive for many people is that they offered more control over the form of computerization and changes in work than systems which ran on shared computer systems. In addition, microcomputer users' work methods made them less dependent upon having access to busy full time computer professionals to design and modify systems. This made their computing arrangements more adaptable. Many organizations implemented PC systems with a tacit social design that gave their workers more autonomy.

A third approach to social design is congruent with both business process reengineering and socio-technical design: web analyses of computing infrastructure (Kling, 1992). One key insight of this approach is that social designs which focus primarily on the overt work system, such as processing an insurance claim or installing a phone line, can overlook the kinds of systems and support which are critical for making computer and communications systems workable for people. For example, in a study of computing and organizational practices in a large number of leading companies, McKersie and Walton (1991:275) observe, "Despite widespread recognition among IT planners that most systems are underutilized because of inadequate training, the deficiency is repeated in systems implementation after systems implementation."

Training is only one element of infrastructure for computing support. We will discuss computing infrastructure in a subsequent section of this chapter. Web analysis locates computer systems

and people who use them in a matrix relationships with other people, organizations and technologies on which they depend. Kling (1987, 1992) provides concrete criteria to help analysts draw larger boundaries around computer and work systems, so that one can examine how they actually work and how they can effectively be changed and sustained. Identifying relevant infrastructure is one part of a web analysis. Identifying other resources, such as data sources and participants' incentives for supporting a work system, is also part of the analysis. When these resources cross administrative or organizational boundaries they are excluded from many systems analyses. Web analyses help social designers include them explicitly.

Here, we can make two key observations. First, computing infrastructure can play a key role in social designs. A group may prefer a high performance computing application which requires substantial training and consulting, or a medium performance application which people may learn more effectively on their own. Whichever application is chosen makes subsequent demands upon computing infrastructure for those work groups. Organizations often fail to realize the gains from IT that they hope for when they: a) select high performance applications and fail to provide needed support or training in their use; or b) select lower performance applications but still do not encourage people to experiment and learn in their workplaces. Our case study of computerization in a research team (Jewett and Kling, 1991; Kling, 1992) illustrates how an Open Natural systems model of organizations is needed to understand what kinds of infrastructure are feasible for specific work groups and work systems.

Second, the analysts who facilitate social designs often use tacit models of organizational behavior. Business process reengineering often rests upon Rational Systems models. Since one overt goal of many of these projects is reducing the number of people employed in an area (often referred to as "downsizing" or "decapitation"), it should not be very surprising that the people who will do redesigned work are often unenthusiastic about sharing their best insights with designers. Natural Systems models of organizations take much more explicit account of people's social behavior (such as seeking occupational security, careers, and specific kinds of economic and social rewards from work). Natural systems models underlie many of the socio-technical design projects. As we shall see below, Closed Natural systems models might help understand what a redesigned work system should look like. But Closed Natural system models are not sufficiently rich to help understand how readily a new social design can be implemented. We shall examine these ideas in the next sections.

5.0

NEW FORMS OF WORK ORGANIZATION

To what extent do new computing and communication technologies foster new forms of work? Many writers, including scholars, professionals and technical journalists, have speculated about the effects of new technologies on work life. These speculations are often based on tacitly-held models of organizational behavior. For example, an analyst viewing organizations from a Rational Systems perspective may speculate that electronic mail will eliminate organizational hierarchies, or at least reduce the barriers to communication between people at different levels of hierarchy in an organization (Sproull and Kiesler, 1991a). From the same perspective, electronic communications may facilitate the formation of more flexible work groups (perhaps even "virtual" work groups). From a human relations perspective -- a Closed Natural systems model -- one might predict that new forms of computerization would create novel possibilities for organizational learning (Zuboff, 1991).

Other speculations involve the extent and the conditions under which electronic communications will foster or undermine a sense of community in the workplace and elsewhere. Workers who are connected by electronic communications media may form "communities" that differ in substantial ways from other communities to which they may belong. Much of what has been written about networks at work has been concerned, in part, with community. A recurring theme of electronically-enhanced group cohesion is typified by Heintz (1992, p 34), who claims that "the world of electronic science is smaller and more tightly knit." This theme tacitly emphasizes the tight relationship of technology and tasks which one finds in Rational Systems Models of organizations.

Unfortunately, there are currently few empirical studies of changing forms of work which support these speculations. Technical journalists like Perry (1992) claim that "electronic mail has removed the barriers of time and place between engineers collaborating on complex design projects." Aydin and Rice (1992) describe how networks bring together different groups in the workplace. There is some empirical evidence that computer nets help foster electronic communities among geographically or organizationally isolated professionals, such as special librarians (Ladner and Tillman, 1992) and oceanographers (Sproull and Kiesler's, 1991a). However, professionals who are already busy with strong professional relationships and nearby colleagues may be much less likely to participate in these semi-public forums. We have observed that the most active researchers in certain areas of computer science rarely post messages on publicly available Internet bulletin boards devoted to specialized topics, including comp.groupware, comp.software-engineering, comp.society and comp.infosystems. One can't infer patterns of participation from a simple Rational Systems description of a task, such as "communicating with colleagues."

But there is also the possibility that people's social relationships in networked offices may suffer in some ways. Research claims about email facilitating less inhibited behavior and flaming suggest that electronic groups may work somewhat differently than face-to-face groups (Kiesler, Siegel, and McGuire, 1984; Sproull and Kiesler, 1991a). Kezsbom (1992), a technical journalist, suggests one possible down-side to networked worklife: "As the use of cross-functional, multi-disciplined project teams increases, the conflict that accompanies such team work will rise accordingly." Markus (1993) describes an organization in which electronic mail is often used to avoid face-to-face confrontation or unpleasant situations, and in which in-office

visitors are ignored while employees tend to the demands of messages on their computer terminals. And Zuboff (1988) reports on a large drug company where managers claimed that their electronic communications were being treated as policy statements, even when they wanted to make an informal observation or ad-hoc decisions.

One recurring theme in this debate, typified by studies of scientists using networks, is the nature of the social relationships and "community feelings" that develop in electronic groups. These groups are diverse. They differ in dimensions like place (same vs different), size of group, and how open or closed participation is (tightly defined project teams vs. discussion groups who are open to all who have accounts on a particular network). Electronic work groups vary widely and behaviors in groups with one set of characteristics may not be important in groups with very different structural characteristics. Small, local closed groups where people also have common face to face meetings may behave very differently than large, open groups where most participants have never met each other and where group norms are developed on-line.

We do not have research which carefully contrasts the nature of social relationships in these different groups, or the interaction between new forms of social relationships and new forms of work organization. It may be much easier for an organization to use email as an "efficient communications medium" for multi-disciplinary groups that meet off-line regularly rather than those who have to meet only on-line.

In this section, we will discuss the impact of computers and communications on intact work groups -- those in which the employees work in close physical proximity to each other on a daily basis. Then we will examine the complexities that arise as communication technologies are applied to distributed groups -- those in which individuals and groups are connected primarily by electronic media, either on the job or in other professional or recreational activities. We will consider the social design implications of an analyst's view of organizational behavior for both proximate and distributed work groups.

5.1 Intact Work Groups

We ask to what extent a group's non-electronic interaction is part of the "glue" which holds the group together. Intact groups often have more in common than simple face-to-face workplace contact: as members of an office, they may participate in parties or other group-sponsored social events that would increase their sense of community. For members of a scientific community, periodic participation in conferences may encourage or reinforce a sense of community, even when their daily communication is solely by electronic means.

Electronic communications can change the static concept of associations within the workplace. Sproull and Kiesler (1991a), describing the second-level, or social, effects of new communications technologies, find that people now "pay attention to different things, have contact with different people, and depend on one another differently." In much the same way as a person may assume different roles outside the workplace (husband/wife, father/mother, golf partner, churchgoer), the same person may now assume different (electronic) roles -- simultaneously -- within the workplace. Several new or expanded roles may be facilitated by electronic communications, such as active professional specialty development or participation in work-related task forces or project activity. Analyses which consider this type of change in work

life go beyond the Rational Systems perspective to show "emergent" behavior of groups that use electronic mail. As this behavior evolves with technological changes, the tasks that a person performs become less stable, and the mix of tasks within a group shift in ways that are best explained by Natural Systems Models.

One of the most intriguing and popular conceptualizations of the potential impact of computing technology on work life is Zuboff's distinction between automating work and informing work (Zuboff, 1988; Zuboff 1991).

To "automate" is to replace human activity with a machine (computer) which is faster, more reliable, more subject to control, etc. The typical goals of automation "have typically been those of cost reduction, efficiency, and productivity. Automation ...means applying technology in ways that increase the self acting and self regulating capacities of machine systems, thus minimizing human intervention.

Intelligent technology can be used to automate, but even as this occurs, the technology has the capacity to translate those automated activities into data and to display those data. Information technology symbolically renders processes, objects, behaviors and events so that they become visible, knowable and sharable in a new way." ... The word I have coined to describe this second function is 'informate.' 'To informate' means to translate and make visible; 'informating' occurs as processes, objects, behaviors and events are translated and made visible as explicit information....

Under these conditions, 'to work' becomes more abstract, since it depends upon an understanding of, responsiveness to, and ability to manage and create value from information. In an informed environment, skills are refined." ... "It requires the construction of a new kind of knowledge, one that is more analytical, abstract, and conceptual....It is in terms of this second informing function that information technology represents a radical discontinuity in the history of work and the evolution of industrial technology." (Zuboff, 1991:3-5).

Zuboff reports an intriguing case of informing in her study of an Expense Tracking System (ETS) in a paper plant (Bronsema and Zuboff, 1984; Walton 1989:142-149; Zuboff, 1988: 255-267). Operators in the paper plant learned about the costs of making paper from a computerized system that had been added to their existing paper making equipment. By experimenting with their equipment controls they were able to significantly reduce the costs of producing paper. The costs of chemicals and other ingredients in paper-making were previously unavailable to operators in real-time. The ETS is a great illustration of informing.

A key problem in the ETS case was the implementation process. While upper managers in the firm originally viewed the ETS as a risky project, they were pleased with the cost reductions and praised the staff involved. The managers who initiated the ETS bypassed some middle managers and worked directly with the machine operators to help give them a sense of ownership over the ETS (Bronsema and Zuboff, 1984). When the operators' results from using the ETS proved valuable to managers in corporate headquarters, these middle managers felt left out and worried about the security of their jobs. They tried to share in the glory of ETS' use by adding their names to key reports. Later they initiated policies to limit and impede operators' abilities to experiment with it. Informating the machine operators empowered them in ways that threatened

their immediate managers, who in turn acted to protect their jobs and status. Themes such as worker ownership and empowerment reflect an underlying human relations (Natural Systems) perspective. However the concept of informing focusses upon the closed system of a job, information recorded about some work processes, and feedback to workers about their performance. As Zuboff shows in the ETS case, managers who are located outside of this segment of a work system can play a major role in facilitating or impeding an informing strategy.

Zuboff's distinction between informing and automating has become the center of significant attention and unpublished controversy. Her catchy and vivid imagery has stimulated some scholars to rethink their approaches to computerization (e.g., Walton, 1989; Morton, 1991). We have found that some of our students and colleagues like the resonance of the term "informate" because it suggests a positive and upbeat approach to computerization. We have also been intrigued by the way that some of these same students and faculty have a hard time articulating what an informed workplace would be like, and how much their conceptions often diverge from Zuboff's formulation.

Part of Zuboff's contribution is to squarely place the analysis of computerization and work in a moral framework which values the possible innovations from all workers, including clerks and production workers. And Zuboff's case studies provide vivid testimony to the ways that many managers are frightened of tapping the creative potential of their workers, and thus also risking a loss of their own authority and power. Informing is a great buzzword. Unfortunately, it is hard to identify how many kinds of work could be effectively informed based on Zuboff's particular definition. For example, how would one informate the job of a person who is word processing legal contracts? Zuboff's conceptualization of informing seems to have been inspired by "closed loop" process control systems where blue collar workers can become more analytical when they obtain data (and training) to help them monitor and analyze their own work.

The moral force of informing derives from the use of new technologies and reconceptualized work to empower and ennoble workers. Her conception of informing focusses on people and their work in isolation, even though empowerment tacitly refers to social relationships which extend outside of a particular workgroup. Like other Closed Natural systems analyses, the informing concept isn't rich enough to help us understand when organizations will experiment with new forms of work --or when these experiments will be successfully sustained over a period of time (and when they will be quickly abandoned). This is a common conceptual limitation of many Closed systems analyses, including some our own research (e.g., Jewett and Kling 1990). By adopting the broader perspective of Open Natural Systems models, the analyst can better account for the negotiations and power relationships between the focal group and the diverse outside groups and people with whom they interact.

5.2 Distributed Groups

Many of the speculations about the impact of computers and communication technologies involve the ability of these technologies to facilitate new forms of work organization that are not limited solely to the traditional, integral work place. As these technologies become an increasingly important part of work life, and proliferate even into the home, some writers examined the unique characteristics of the media themselves, and predicted both positive and

negative effects which might result from using the new media. Other writers predicted -- and in many cases strongly advocated -- that electronic communications be used to restructure the traditional social organization of work into such new forms as distributed work groups, telecommuting, and special-interest (possibly non-work-related) groups. We will examine each of these predictions in turn.

5.2.1 Media and Communications

A substantial body of research has attempted to identify the unique characteristics of electronic media, and how new media use may be optimized. While much of this research is social-psychological in nature, a few researchers engage issues of organizational behavior. Kiesler, Siegel, and McGuire (1984) conducted controlled problem-solving experiments which compared computer-based communication with face-to-face discussion. They found that the groups that used computer-communication took longer to reach consensus, participated more equally, showed higher choice shift, and displayed more "uninhibited verbal behavior" (colloquially known as "flaming"). Additional studies by this widely-recognized, pioneering research group, which support and expand these findings, are presented in Kiesler, et.al (1985) and in Sproull and Kiesler (1991a, 1991b). Some of the effects which they observed have been attributed to the absence of non-verbal cues which are present in face-to-face discussion (body language, smiles or frowns, etc.) and even to some extent in telephone conversation (laughter, voice inflection, etc.).

Several investigators have contested the view of email as a medium which alters social behavior because it reduces social cues about other people's social roles and emotional responses. Markus (in press) challenges the interpretation that email always filters out key social cues. In an intriguing case study of the headquarters staff of an insurance firm she found that email use had both positive and negative consequences. Sometimes people wanted social distance in a communication, and they used email strategically to facilitate them. At other times, people sought closer relationships, and they used email and face-to-face meetings to facilitate them.. People became relatively skilled in using email messages to help manage social distance of their relationships. However, Markus also found that the way people related to email had some social effects that they did not intend. For example, most managers gave priority to email messages that arrived (and beeped) on their terminals during face-to-face meetings in their offices. Since email use was routine and frequent, eye contact in face-to-face meetings in a managers office could be frequently broken and conversations halted while the office occupant turned to scan the newest message. Markus informants reported that they found this priority to email in face to face interactions to be socially distancing, and they did not see it as intended strategic behavior. The negative effects that she cited were primarily focused on depersonalization -- including employee feelings that the company was a less personal place to work, feelings of "invisibility," reduced feedback on job performance, and avoidance of personal contact. She argues that in some cases, these negative effects occur as ironic byproducts of people's attempts to avoid potential problems with system use. Lea and his associates (1992) have also re-examined much of the literature on "flaming" in electronic mail. They re-interpret the evidence to suggest that flaming is much less widespread than has been reported, and that it is very much dependent on the context in which the systems are used. Lea suggests that if flaming depended only upon using email, then people should flame at comparable rates on all bulletin boards, including all newsgroups on Usenet/Internet. However, they observe that flaming is relatively common on some

Usenet/Internet newgroups and comparatively rare on others. Something other than "email use" and "cueless media" must be invoked to explain these differences.

The systematic study of media effects pre-dates the emergence of email and was initiated to help understand the role of telephones in personal communication. The research was extended by scholars like Short, Williams, and Christie (1976), who compared face-to-face conferences with audio-only and audio-plus-video techniques. Ronald Rice has examined the tasks which are most appropriate for a wide range of new media (Rice and associates, 1984; Williams, Rice, and Rogers, 1988). One key finding (Rice, 1989; 1992b) is that richer media (e.g., video conferencing) are more suited to less analyzable tasks, while less rich media (e.g., electronic mail) are appropriate for more analyzable tasks. Although these findings are useful in many situations, they are based on a Rational Systems model of organizations.

To illustrate the difference between Rational and Natural Systems perspectives, we will contrast a recent technical press description of the latest "groupware" software packages with a careful study of actual groupware use in a prestigious organization. In a *PC Magazine* sidebar, Ulanoff (1993) offers a choice of groupware for five types of work groups (with catchy names such as the "worn-sneakers" group) and suggests which software packages will meet the needs of each group. On the other hand, Orlikowski (1992) illustrates a situation in which the Chief Information Officer (CIO) of a large international consulting firm carefully chose a new groupware package (Lotus Notes), but failed to implement an incentive structure that encouraged its use. The CIO expected consultants to share case reports about common consulting issues with their colleagues in other offices. He believed that the consultants would use Lotus Notes to learn from each other, and to save time if they encountered a problem that had already been solved in another location. But the consultants' incentive structure was based on having "billable time" from clients for each of their activities. The firm's managers failed to modify this incentive structure. The consultants had no way to bill the significant amount of time for learning to use the new software¹² or time that they would spend writing case reports that might help another consultant in another office. An analyst using a Natural Systems perspective could have recognized in advance the conflict between the assumed incentives and the incentives that were actually in place. The resulting explicit social design then could have included, for example, a company-wide "overhead" fund for the new work tasks that consultants would perform with the new software.

A Rational Systems assumption of the related "media richness" and "cues filtered out" theories is that communication between employees -- by whatever media -- will always be focused on task-related topics. From a Natural Systems perspective this is not likely to be the case. A recent study of office life found that a large percentage of employees report spending many of their working hours in non-work-related conversations and activities (Bozon and Lemel, 1989). Suppose, for example, that an employee enters the office one Monday morning wearing a cast on his leg. If the same employee interacted with his colleagues only by electronic media, the cast would be effectively invisible. But in a face-to-face setting, this non-task-related cue would almost certainly become the focus of conversation: "What happened?" ... "Ski accident" ... and so on. Many other non-task-related cues could have a similar effect: the sudden appearance (or

¹² It can take a person 15-30 hours to learn this particular package (Lotus Notes); see the review of Lotus Notes in Stevenson (1993).

disappearance) of a wedding ring, or even a new hair style or color. We would argue that the richer, Natural Systems models are needed for analysts to understand this behavior, to evaluate the practical differences between electronic media and other forms of communication in the workplace, and to develop social designs which accommodate non-task-related as well as task-related activities.

5.2.2 Distributed Work Groups

One major change in work organization following the introduction of electronic mail and other new communications technologies is the formation of new, geographically-distributed work groups. Although there are few systematic studies of these groups, there are numerous accounts which point to their growing importance. These groups may be short-lived, with a specific one-time task to perform such as a new product design. They may also be ongoing and broad-purposed, as in the case of the Tandem Corporation where 10,000 field service engineers use a particular bulletin board to discuss technical problems (Sproull and Kiesler, 1991a). "Electronic teams" may also extend in membership beyond the boundaries of a single corporation or university: one of the first and most famous interorganizational electronic teams was formed to develop the Common LISP programming language. Steele (1984, quoted in Sproull and Kiesler, 1991a) claims that the design of the Common LISP programming language project would not have been possible without electronic mail to facilitate communication between hundreds of computer scientists in numerous organizations around the globe. Many other published examples of distributed work groups are primarily engineering teams in high-technology firms such as Digital Equipment, Hewlett-Packard, and Sun Microsystems (Perry, 1992). Perry's focus, like that of many other writers, is on the contribution of electronic communication systems to specific job task performance. This focus assumes a Rational Systems Model of the organizations that use the new technologies. From this perspective, many of the features that Perry ascribes to electronic mail systems are impressive: for example, the ability to send help requests to 10,000 people simultaneously, the round-the-clock work structure of design teams that span global time zones, and the easing of language barriers in a U.S.-Russian design collaboration.

Both Perry and Sproull and Kiesler also list some "down sides" of electronic mail, including the impact of a 10,000-copy request on the 9,985 addressees who do not have an answer, or for whom the question is irrelevant. But as in intact work groups, the emergent natural phenomena of electronically-connected distributed work group behavior may be far more complex than a listing of "advantages versus disadvantages" can reveal. The Open Natural Systems perspective can also enrich our understanding of distributed work groups. One example of an issue that an analyst might consider is the impact of new group structures on career lines and promotion opportunities for group members. In the Tandem Computer illustration, one could examine the incentives for field engineers to spend time helping the peers in other parts of the world, rather than spending the same time with their own customers and peers in their office in face-to-face contact. An implicit social design, for example, might base their promotion on some reported measure of customer satisfaction, thus limiting their enthusiasm for helping remote colleagues. An explicit social design could look beyond the person and the specific task-oriented group, to recognize and reward collaborative behavior.

5.2.3 Telecommuting

Telecommuting is one of the most misunderstood phenomena related to work with networks. Futurists like Alvin Toffler have been enamored with the possibility that people who commute to a collective office could elect to work at home. In *The Third Wave*, Toffler (1980) portrayed homes with computer and communications equipment for work as "electronic cottages". This concept, with labels like "telecommuting" and "telework," have been the subject of numerous studies.

Some writers speculate that richer multimedia information systems, such as those supported by Integrated Services Digital Network (ISDN), may lead to more telecommuting because they would support more effective conferencing. But managers often computerize work with several competing logics, in which conferencing ability may be only a subordinate consideration. They may be concerned with maintaining some control over their subordinates' time and pay, but also with allowing sufficient flexibility and self-direction to insure quality work and retain good employees. Certain organizations may pay less but attempt to offer attractive working conditions -- one of which could be to allow full time workers to work at home part of the work week. This is relatively rare because of the problems created with workplace control, although many self-employed people do work at home.

The possibility of firms giving employees computer equipment to use at home while communicating with their offices via electronic mail opens up many possibilities (Kraut, 1987a; Kraemer & King, 1982; Olson, 1983; Olson, 1989a; Huws, Korte, and Robinson, 1990). Working at home might decrease urban traffic congestion during commuting hours, give parents more opportunity for contact with young children, and allow people to spend more time in their neighborhoods. However, people who work a substantial fraction of the time at home may be unavailable for meetings with colleagues, less visible to their peers and (therefore) passed over for promotions, and would be difficult to supervise unless they worked on a piece-rate system. Some people may lack sufficient self-discipline for work at home. Managers and researchers should consider how well electronic community-building via computer networks can compensate for loss of the traditional workplace community.

Popular accounts frequently claim that home may be a less distracting place to work than the collective office. Closed Rational Systems assumptions underlie this claim, as that model leads one to examine only the worker (in isolation) and the specific job tasks to be performed. We both do a significant fraction of our work, especially reading and writing, at home. Experience has taught us that home is a different kind of place to work -- with its own privacies and problems. Homeworkers report a different set of attractions and distractions at home: sociable neighbors may expect to be able to drop in any time; children returning from school demand attention in the middle of the afternoon, the refrigerator may beckon others too frequently, and so on. Some parents choose to work at home because they can spend time with their babies and pre-school children, but they often accomplish less than at their traditional offices. Olson's (1989a) study of full time work at home by computer professionals exemplifies some of the empirical studies. She found reduced job satisfaction, reduced organizational commitment and higher role conflict in her sample. She also wonders whether work-at-home practices can exacerbate workaholism. These reports may be puzzling unless one looks beyond a Closed Rational

explanation to an Open Natural understanding that is more congruent with the telecommuter's actual activities.

Forester (1989b) recently critiqued the visions of full-time work at home via telecommuting as a romantic preference. After coming to appreciate the social isolation reported by several people who worked at home full time, he speculated that many of the most ardent advocates of full time work at home with computing have never done it themselves. Whether organizations will allow substantial fractions of their workforce to work at home with computing part time (1-3 days a week), for reasons of personal flexibility or to reduce commuting remains an open question. Few homes are designed for efficient home offices, and there are many important questions about the pros and cons of part time work-at-home with computing (and fax) for those who prefer this option. (See Vitalari and Venkatesh (1987) for an assessment of in-home computing services that examines work-oriented technologies among other systems).

A few organizations have conducted limited pilot tests of telecommuting. But these organizations and others keep the majority of their desk-bound work force keystroking in the office rather than at home. Workers may be given computer equipment to use for unpaid overtime work. To date, however, no large firms have dispersed a large fraction of their full-time work force to their homes or even satellite work centers to work with computer systems. Members of a few professions, such as journalists, professors, salesmen, and accountants take notebook computers on the road when they travel.

The desire to maintain control underlies many managers' fears of having their employees work full-time at home. It is easier for managers to ensure that people are putting in a fair day's work in an office from nine to five, than to work out elaborate contracts about the work to be done each week or month. This is an implicit social design, which emphasizes control. Employees may have different fears, such as reduced promotion opportunities that may result from lack of personal contact with managers. Further, office workers often find it easier to coordinate with people who are often wanted for meetings if they are in their collective offices. Work at home increases tensions about control over work. This is most evident when high technology firms, whose marketers promote the visions of bountiful technology for all, refuse to let a significant fraction of their professionals work at home part time as an alternative to the daily grind of urban commuting. An explicit social design which accommodates the interests of both management and employees could facilitate change in ways which technology also has so far failed to do.

5.2.4 Distributed Common-Interest Groups

Electronically-connected groups are not limited to those within a single workplace or to those within a single (possibly geographically dispersed) organization; nor are they limited to those with a single, narrow task focus. A more open-ended group may be composed of people with common professional interests or specialties, separated by geography but using electronic mail or bulletin boards to maintain contact. An illustrative case is that of special librarians -- experts in a very specific (and perhaps narrow) field of research literature -- each of whom is a library's only specialist in that field. Ladner and Tillman (1992) have found that these people rely heavily on electronic communications to link them with others in their own specialties. (They also report their research results electronically!) Oceanographers (Sproull and Kiesler, 1991a:164) are among the many scientific communities who have specialized electronic network support

available to them. One intriguing aspect of these groups is that they allow their participants the opportunity to develop their own culture, distinct from the culture of the workplace, as Tom Finholt and Lee Sproull found in a recent (1990) study.

Even people with little or no common work tasks or professional interests may participate in electronic groups in the pursuit of hobbies, recreation, or social contacts. People have traditionally formed social clubs -- ranging from formally organized and structured associations to loose, *ad-hoc* gatherings -- that are centered around common interests such as hiking, sports, movies, and the like. Today, similar groups may form around electronic bulletin board activity -- forums which may be as simple as a local "dial up" number for exchanging information about a single computer game or as complex as the nearly 2000 topics available to Internet subscribers worldwide.

For any of these groups, the number of core participants may be an important factor in sustaining group activity -- there may be a minimum number of regular contributors below which the group may cease to function. Markus (1987) made a major contribution to the understanding of electronic communication by examining the extent to which some minimal fraction of a social unit's members, "a critical mass," must be available via email for many people to find it useful. Markus articulated a simple critical mass model in which connectivity must be "all or nothing"; that is, all members of a group must be electronically connected in order for the group to function through the electronic medium. While this criterion is idealized, it helps Markus show how sustained electronic group behavior is a community-level phenomenon.

Markus focussed on email, but her critical mass theory also applies to interest groups which communicate via distribution lists and bulletin boards. For example, the committee members of a professional society may attempt to use a distribution list to conduct some of their business. Our informal observations support Markus observations about email. Unless most of the committee's members use email regularly, the electronic forum will not function very well. Markus' observations also extend to bulletin boards where participation is voluntary, such as those on the Internet. We have observed that at least 50 to 100 active members are needed to sustain most electronic groups in which participation is voluntary (that is, not required by specific job tasks)¹³.

Special-interest electronic groups may support the normal interests and activities of a work place or they may cause conflict. Zuboff (1988:382-383) studied an organization in which a group of about 130 professional women formed a private electronic conference that threatened male managers. This case is particularly illustrative of the explanatory power of Open Natural Systems models, since it involves activities that were conducted in the workplace but addressed subject material -- in this case, women's issues -- that are much broader in scope than simple work-task performance. Participation in this group was discouraged by upper managers and many participants dropped out. Managers may not have explicitly considered themselves as censors. But their implicit social design of this aspect of the work setting nevertheless contained a strong element of censorship. It would not be surprising if electronic communications systems are used

¹³ An empirical survey might support or refute this prediction; evidence for or against it might also be gathered by computer-modelling the group process, as Tom Finholt suggested in a personal conversation with one of the authors.

in practice primarily to form groups that upper managers deem to be safe, except in those special organizations --like universities and R&D labs -- where there are strong norms against censorship.

Speculations about the possibility of computerization fostering new forms of work organization may be very engaging. Enthusiasts of the position that computerization can lead to new forms of work have the advantage of offering exciting possibilities. However, they rarely face the complexities of social control which are central in Natural Systems models and which we examine in the following sections.

6.0 CONTROL, COORDINATION AND COOPERATION IN ELECTRONIC WORKPLACES

The models of organizational behavior which we have presented thus far illustrate two important dimensions along which analysts may inform their explanations of the changes which accompany the introduction of new technology in the workplace. But although models in each quadrant of our organizing table (Table #3) share many basic assumptions, each quadrant also includes a whole family of models which may differ substantially along dimensions other than open/closed or rational/natural. One example of a separate dimension which characterizes analytical perspectives is that of control versus cooperation. Analysts who see organizational conflict as chronic, cooperation as bounded and patterns of control as often in contention, are likely to share a Natural Systems perspective.

At one extreme, the Neo-Marxist perspective divides people who work into two broad categories: owners and their managerial representatives on the one hand, and workers of various kinds on the other. Neo-Marxists assume that these two classes have very strong conflicting interests, and that class-conflict is the primary basis for workplace conflicts. An influential analyst, Harry Braverman (1974), argued that the logic of capitalism requires owners and managers to relentlessly enhance their control over workers to reduce labor costs. Braverman's theory has been influential in shaping critical studies of technology in worklife. In the images of Mowshowitz (1986) and Perrolle (1991) (which follow Braverman's argument), managers computerize so as to tighten control at every turn¹⁴. Braverman's theorizing has the advantage of analytical simplicity. It highlights important structural conflicts between managers and their subordinates which many people who write about computerization ignore. This leads analysts to focus on "bad workplaces" where people are low paid, have dead end-high pressured, repetitive jobs, and tight supervisory control, as well as "good workplaces." And there is certainly evidence that managers have developed social designs with computing where the resulting work is simplified and more tightly controlled. For example, Kraut, Dumais, and Koch (1989) report a case study of customer service representatives in a telephone company in which simplifying work was a major consequence of computerization.

¹⁴ Barbara Garson (1988) wrote a popular set of cases of computerization and work in white collar sweatshops which reflects Braverman's views. While her stories of humdrum low paid work and petty supervisors are very gripping, she doesn't go outside the immediate workplace to understand how these work practices develop. Also see Carlsson and Leger, 1990.

But during the last decade, Braverman's labor process theory has been subject to significant criticism (Attewell, 1987; Kuhn, 1989; Wood, 1989:10-11). Critics of Braverman's labor processes theory fault him for treating workers as purely passive agents. Further, Braverman's theory also ignores the variety of managerial approaches for improving productivity, such as those which increase responsibility, pay and morale, rather than tightening control and de-skilling (Jewett and Kling, 1990).

At the other extreme are Rational Systems analysts who assume that cooperation, rather than control, is the dominant element in work groups (e.g., Ellis, Gibbs and Rein, 1991). These analysts are often interested in developing software to enhance cooperation within and between groups. However, they often assume that technologies labelled as "computer support for cooperative work" will usually be used in cooperative workgroups and that elegant groupware will readily improve a work group's performance.

Although we find both extremes to be overstated, the issue of control and cooperation is one which is important to the social design of computerized workplaces. Much of what has been written about social design tends to be normative in nature. But what we know about control of work comes primarily from analytical studies. Lacking normative guidelines in the area of control, writers on social design frequently -- and unfortunately -- ignore the entire issue. We argue in this section that analytical studies of control and coordination in the workplace may be used to provide behavioral grounding for ideas about social design.

The importance of such a behavioral ground in forming design choices can be illustrated by analogy with architecture. From the 1930s to the 1950s, many large-scale public housing projects were constructed as high rise apartments in a sea of asphalt (Hayden, 1984:122-123). The architects of these projects seem to have paid little attention to the social behavior of people who would inhabit their buildings (or, in computer system terms, their "users"). They seem to have conceptualized the boundaries of a project as encompassing only the structure and its sculptural properties, a view which is analogous to a Closed Rational systems model. Some of the larger public housing projects became squalid housing, with defaced or graffiti laden walls, and unsafe for many residents. One large housing project, Pruitt-Igoe in St. Louis, was designed in the mid-1950s and dynamited in 1972 by the agency which had built it. A film of the event showing a row of high rise buildings crumbling after the blasts is much more dramatic than most scenes of failed computer systems which go quietly unused. But the similarity is that artifacts of many kinds may not function well when their (implicit or explicit) social designs do not foster workable social systems.

6.1 Electronic Support for Managerial Control of the Workplace

Analysts who fear that managers will use computer systems to tighten control over workers have focussed on the issue of electronic monitoring. Defenders of electronic monitoring argue that managers have a right to know how effectively their subordinates are working, and whether they are slacking off. When computerized work is relatively private and reflected in shifting screens rather than lines of people or stacks of paper, managers need new ways to learn how their subordinates are working. Critics of electronic monitoring argue that it is oppressive, unobtrusive and pervasive. The manager who walks around to see how her staff are working can talk with them about the nature of the work, the organization, and their personal lives. They can

build solidarity in their work groups, although much depends upon their abilities to develop rapport and communicate. In contrast, the supervisor who stays at a distance from her subordinates and has frequent measures of activities such as keystrokes, transactions or phone calls can create a pervasive judgmental presence. They have fewer occasions to build workgroup solidarity and motivate through commitment rather than fear.

In "Big Brother and the Sweatshop" Paul Attewell (1991) examines five theoretical approaches to help understand the typical uses of computerized workplace monitoring. He notes variations in the way that business firms and public agencies organize work and technology. Attewell examines the differing predictions which one would make by using five different theoretical approaches: corporate culture, neo-Marxism, product lifecycle, contingency theory, and industrial sociology. He argues that managers have tremendous incentives in principle to learn about and control the work of their subordinates. But he observes that many practical conditions weigh against their using computer systems as instruments of surveillance in the vast majority of workplaces. Attewell's article is specially important because of the care with which he examines a variety of supervisory strategies and how managers work with and without computerized monitoring systems. He notes that managers are concerned with controlling many resources, not just labor. For example, it's likely that the manager of a work group that manages multi-million dollar investments will pay more attention to the quality of decisions being made rather than a few thousand dollars in salary costs. In contrast, the manager of a work group where labor is the most costly resource and where judgmental errors are unlikely to be catastrophic may be very anxious to shave a few thousand dollars off of the payroll by having people work to their maximum. Attewell (1991:252) develops an alternative model Open Systems model that integrates elements of the organizations' environment, culture, business strategy, work organization and labor market conditions.

While Attewell asks about the conditions under which organizations will monitor the activities of their staffs, Grant and Higgins (1991) ask about the effectiveness and repercussions of monitoring service workers, such as those who audit insurance claims. They developed a rich, multidimensional concept of monitoring which includes features such as the granularity of data, the range of data collected, and the variety of people who routinely see data about a person's work. They found that many people did not object to computerized monitoring. But they also found that monitoring does not always improve performance and the quality of service. In fact, service seemed to degrade most when many aspects of performance were monitored and made available to supervisors. Grant and Higgins view monitoring as a legitimate but subtle form of managerial intervention -- in our terms, a social design -- which can often backfire when system designers and managers do not pay close attention to people's indirect responses to monitoring.

6.2 Patterns of Professional Control

Issues of control and cooperation are not limited to workplaces that where blue collar production workers or clerks are predominant. It may be easier to conceptualize a technical or professional work group as primarily cooperative. But some analysts, like Pelle Ehn, have argued that all work is fundamentally cooperative. Kling (1991b) criticized this position and noted:

Most workplaces are much less coercive than chain gangs. But the primary alternatives are not simply limitless cooperation, as if these are all-or-nothing characteristics of group relations. As Grudin points out in the case of group calendars, most professionals are not so eager to cater to their managers' preferences that they will continually inconvenience themselves and lower their productivity in order to help their manager's secretary schedule meetings. They are somewhat cooperative, but also somewhat autonomous and self-oriented. Further, some kinds of conflict in groups is critical for identifying alternative lines of action and avoiding groupthink, as long as conflicts are resolved constructively and with dignity. In practice, many working relationships can be multivalent, mix elements of cooperation, conflict, conviviality, competition, collaboration, commitment, caution, control, coercion, coordination and combat (just to stay with some "c-words"). They also involve attention to substantive tasks, managing the organization of work, genuine sociability, and even play.

It is also possible to conceptualize even a technical or professional workplace as subject to rigorous and increasing managerial control. Perrolle (1991) examines how managers can use expert systems and other advanced computer technologies to reduce the skill levels of professional jobs. Perrolle draws on Harry Braverman's (1974) argument that owners and managers relentlessly try to enhance their control over workers to reduce labor costs. One major managerial strategy is reducing the skills required for most jobs, thus enabling them to hire less expensive workers. Perrolle illustrates this theme through the example of computerized "application generators". Some of these facilities simplify the production of computer programs so they can be written by clerical workers paid \$20,000 per year, rather than by university-trained programmers paid \$40,000 per year. Perrolle argues that expert systems may also be applied toward reducing the skill levels required for professional jobs. As skill levels of jobs are reduced, so is their pay, autonomy, status, and perhaps their intrinsic interest.

Perrolle's argument ignores fundamental aspects of the computerized professional workplace. Spreadsheets, like Lotus 1-2-3 and Microsoft's Excel, are the primary software types that fueled the market for PCs in businesses in the mid-1980s. While it is possible to regiment and de-skill jobs with spreadsheets, the majority of applications are geared towards professionals and/or their clerical assistants. It is likely that professionals and managers, rather than clerical workers, will be the major users of any new information systems, absorbing these innovations at a higher rate than local programmers can devise them. Organizations and work groups frequently standardize their software; word processors, databases, and spreadsheets. This does not, however, automatically regiment the overall character of work.

In a rich and provocative field study, Wanda Orlikowski (1991) examines how a large international computer-consulting firm used Computer Assisted Software Engineering (CASE) tools to reorganize work. Unlike other cases in which social design was implicit, this firm has adopted a very explicit social design -- but one which is still based on a Rational Systems view of the workplace. They hire college graduates and MBAs with no significant professional computing experience and trains them with their own methods. It reviews the newer consultants with tough "up or out" hurdles every two years. Orlikowski's account of this firm's use of customized CASE tools has some important parallels with Perrolle's (1986) characterization of intellectual assembly lines. The CASE tools were designed to enforce a specific sequence of design activities, for example by requiring that data tables be fully defined before they are used in a program. The firm spent less effort in training newer recruits than they spent on similar

employees in previous years. She reports that the younger consultants did not realize that their jobs required less skill for them than for consultants who had worked without the CASE tools. In fact, they liked the windowed CASE tools with easy-to-use menus and the ability to easily edit changes without rewriting whole documents. Some of the intermediate level consultants had found key ways to work around some of the CASE tools' restrictions when they were working in a time crunch, but managers frowned on these workarounds.

Kling and Iacono (1984) take a different approach to workplace monitoring and the control of work. Their empirical study -- based on Open Natural System assumptions -- examines the ways in which computerization alters social control and coordination in workplaces. Most analysts who examine the use of computer-based systems to tighten social control rely upon some conceptual model of managerial authority. Kling and Iacono introduce an "institutional model of social control" in which information can flow in any direction (up, down, and laterally) and in which people in different organizational units can try to enforce norms upon people in other organizational units. Kling and Iacono observe complex patterns of negotiation and control that go beyond the traditional hierarchy. They rigorously compare the explanatory power of the institutional model with two other models, hierarchical managerial authority and negotiated order (which focusses upon lateral peer relationships). The institutional model of social control is important because it shows that social behavior can be controlled through information flows and people that extend beyond the immediate behavior setting in which workers use computer-based information systems. Further, they showed that a workers' peers, or even people who are lower in the hierarchy, can use certain kinds of operational information systems to control other's behavior. Kling and Iacono focussed their study on complex inventory control systems in manufacturing firms. But their points pertain to groupware or any other computerized system where peers can see each other's work performance through the system. Their study suggests the type of research that may be appropriate -- but has yet to be done --leading toward a different portrait of organizational control patterns and different ideas about the social design of work.

7.0 THE INTEGRATION OF COMPUTING INTO WORK

The vast majority of articles and books about computerization and work are written as if computer systems are highly reliable and graceful instruments. From a Rational Systems perspective, integration of these systems into the work place is relatively unproblematic; the few issues that might arise are solvable by purely technical means (e.g., converting files from one format to another, installing compatible communications processors, etc.). There are relatively few published studies of the ways that people actually use software systems in their work -- which features do they use, how do they meet and resolve problems caused by systems or gaps in their own skills and how does the use of computerized systems alter the coherence and complexity of work? From a Natural Systems perspective, systems -- including the people who use them and the work places in which they are used -- are much more dynamic at all levels. Integration therefore becomes a much more complex issue --one which is not resolved at installation time, but continues throughout the life of the system. Whether or not system designers face this issue, the people who use the systems *will* face it; their work life depends to a large degree on the gracefulness (or non-gracefulness) of the ongoing integration process.

7.1 Anomalies

In "The Integration of Computing and Routine Work," Les Gasser (1986) studied anomalies common in the daily use of computing systems. Anomalies are discrepancies between a person's expectation of behavior and the actuality. Anomalies include system bugs, but they go much further. For example, in 1990 the State of Massachusetts billed the city of Princeton, MA one cent in interest after it paid a bill for a ten cent underpayment of taxes. Each of these transactions cost a postage stamp, as well as several dollars in staff time and computing resources. The Wall Street Journal reporter viewed the situation as anomalous because one would not expect organizations to routinely invest many dollars in attempting to collect a few cents. However, the computer program was probably working as it was designed -- to compute interest on all underpayments and produce accurate bills for interest due to the State of Massachusetts.

Gasser views computer use as a social act rather than as an individual act. He discusses computerized information systems that are developed, used, maintained, and repaired, by teams of people -- people who relay their beliefs about system values, uses, limits, and problems to their co-workers. In addition, the people in Gasser's study depend upon other groups in their organization for key resources such as data, training, and equipment fixes. Anomalies occur due to the interactions between these groups, which are not organized like firemen to race to each other's aid at a moment's notice.

Gasser argues that discrepancies are widespread. The anomalies of computing may be reduced by improved equipment, but they cannot be eliminated. Gasser's argument sheds some light on the question of why computerization may not enhance productivity as readily as many analysts expect. It gives us insight as to why certain jobs become more complex with computerization -- since men and women who use computers sometimes need to account for these differences and work around them.

Users of network systems, too, may encounter anomalies. Some writers compare these systems in terms of features, ease of use, and similar criteria (see for example Hiltz and Turoff, 1978; Derfler, 1989; Bullen and Bennett, 1991). But system-comparison articles seem to assume that each organization will choose *only one* system to implement, that each user will learn and use that system and that system only, that the chosen hardware/software package will support all possible connectivity requirements of all users in the organization, and that the system will remain unchanged for long periods of time except for periodic "improvements" and added efficiency-producing features. But some organizations may use multiple and dynamically-evolving network systems. Our own experience provides an example: we use PCs as terminals to connect with two local area networks and at least two mainframe computers and one commercial network. On these platforms, we use three communication programs, four word processors, and five network mail programs --plus information retrieval programs and many utilities. All of the hardware and software has evolved over a long period of time; all of it is continues to evolve.

In a system such as this, it is not surprising to find incompatibilities and features that are far from "user friendly". Multiple software packages require us to remember at least 14 different keystroke combinations even for the "simple" task of exiting a program. Electronic mail addressing schemes differ widely between the systems; for example, we are easily able to find the address for any user of the Academic Computing mainframe but are often unable to locate people

who use the Graduate School of Management (GSM) system. At GSM, it is easy to attach documents in a variety of formats to any electronic mail message. Unfortunately, these attachments cannot be easily read correctly when the message goes outside the local network¹⁵. The authors regularly transmit documents from one home to the other through the intermediary of PC-to-mainframe file transfer; these documents can even retain the imbedded formatting information of our common PC-based word processor. But we cannot decode documents originated by colleagues or students on Macintosh systems --without using awkward off-line translation procedures. We communicate easily and frequently with colleagues in Brussels and Zurich who are linked to compatible network systems. But we are excluded from communicating with colleagues located in our own local area who use incompatible networks.

7.2 Time Saving and Time Consumption

We have illustrated elsewhere (Jewett and Kling, 1991) the "hidden" time and skill demands of computerization in an office setting. Networks and electronic communications can intensify these problems. In most accounts of electronic communications, basic on-demand connectivity from the user's terminal or computer to a network is simply assumed to be present. But even this minimum requirement may not always be guaranteed or timely. Both authors, when they are working from home, dial into a network system through ordinary telephone lines. In one case, this telephone line is shared with the rest of the family, which means that occasional waiting for access is inevitable. Even the other author's dedicated "computer-phone" line fails to solve the problem of a busy-signal at the other end; university networks are notoriously sensitive to semester-end overload as students -- who also have access from their home computers -- rush to complete assignments simultaneously. In the worst case, telephone lines may fail entirely, preventing all network use for an extended period of time; this actually happened to both authors during a series of winter storms. Once the delays have been overcome and connectivity has been established, other time-consumers come into the foreground: time-consumers associated with each of the major models of network communications.

Some people may rely upon electronic-mail to communicate with others. Many groups provide a "distribution list" which makes it easy to send a single message simultaneously to a particular group of people. This capability is often mentioned as one of the key advantages of electronic mail. Distribution lists are used at many sites that have been studied by academic researchers (e.g., Sproull and Kiesler, 1991a). But since many messages apply to only some people who subscribe to any specific distribution list, many subscribers may receive a large number of messages that they see as irrelevant to them. One of the few complaints reported in Hiltz' (1984) survey focused on "group messages that are voluminous, unnecessary, or of little general interest." Many of the respondents in one of our own studies also cited too-frequent use of large distribution-list addresses as a problem for them, especially for messages which only affected a few people. Regular electronic mail users expect to perform some amount of routine maintenance work in sorting, filing, cataloging, and retrieving these messages. Only some email systems provide easy-to-use software tools to support these activities.

¹⁵ These documents are usually transferred in a binary encoding. A skilled person can read them if they use a facility like Unix's UUDECODER.

The unfortunate person who, by choice or necessity, participates in many distribution lists can easily have his or her electronic "inbox" filled each day to unmanageable levels. Tom Finholt, an active researcher in the electronic communications area, reported to the authors the case of a person working in one of his research sites, who belonged to 450 electronic mail distribution lists. Even at much less dramatic levels, the quantity of messages -- from both distribution lists and individual correspondence -- can be problematic. One author's inbox varies from 15 to 50 messages each workday. But when he travels, he is sometimes unable to connect with his home system. This can cause an accumulation of perhaps 300 to 400 messages, which may take from 5 to 8 hours to work through after his return home -- which in turn causes understandable family resentment at the additional "lost" time.

An alternative to distribution lists is communication via electronic bulletin boards, in which messages are posted by individuals but are publicly available for reading by anyone who uses the network. Among the most popular bulletin board systems are those of the Internet, which is a system that is widely available both to universities and to private research organizations. These bulletin boards are organized hierarchically by topic, with major headings such as "comp" for computing, "rec" for recreation, and so on. Some of the boards are accessible to anyone for direct posting of messages; some are moderated (that is, messages are sent first to a person who serves as moderator, who then sorts, edits, and posts blocks of messages for reading). The total of board topics on the Internet now numbers nearly 2000 -- many more than any one person is likely to even casually scan. Some of these topics attract only a few messages per day, or per week. But others can vary up to hundreds of messages per day, for example political themes during the presidential campaign or Gulf War-related topics during that crisis. To the reader, this quantity of messages can be overwhelming.

Another major function of electronic communications is to locate and transfer information among the many sites on a network. Measured by sheer volume of data transmitted, this is actually the most common use of the Internet -- and it is growing in relation to other functions such as mail and bulletin boards.¹⁶ There are software programs which facilitate this process; one which is becoming increasingly popular on the Internet is called "gopher" (with pun no doubt intended). From a Rational Systems perspective, virtually instant access to thousands of data files which are maintained on hundreds of computers worldwide should offer inescapable efficiencies for "knowledge workers" such as researchers and journalists. This advantage may be realized in some cases. But even the most efficiency-minded information-searcher may take many false turns through multiple levels of access menus, and may spend a great deal of time browsing through information of peripheral value at best. The commercial "value-added" networks (for example, CompuServe) are designed to encourage their clients to spend as much (chargeable) time as possible doing just that: browsing through mountains of information, whether it is of peripheral value or not.

¹⁶ This information itself was obtained through Internet file transfer from <NIC.MERIT.EDU> /nsfnet/statistics/history.ports, thanks to Dr. Steve Franklin, U.C. Irvine Office of Academic Computing.

7.3 Infrastructure for Supporting Computer Use

Workable computing arrangements depend upon a set of supporting physical, technological or social resources. Physical resources include space for equipment. Technological resources can require electricity and communication lines. Social resources may be comprised of people skilled in the use and repair of equipment as well as the practices for allocating resources. These collective resources are termed the computing infrastructure by Kling and his colleagues (Kling and Scacchi, 1982; Kling, 1987b; Lepore, Kling, Iacono and George, 1989; Kling, 1992).¹⁷

The social infrastructure for supporting people's use of computing is a key element in any computerization effort (Kling and Scacchi, 1982; Gasser, 1986; Kraemer *et al*, 1985; Kling, 1987B; Jewett and Kling, 1990; George, Kling, and Iacono, 1990; Jewett and Kling, 1991; Bullen and Bennett, 1991). People report having better quality worklives in workgroups where the computing infrastructure for supporting training and consulting is best developed (Lepore, Kling, Iacono, and George, 1989). Further, financially poorer organizations, like many public schools, sometimes have trouble effectively using gifts of advanced computer systems because of weakness in their computing infrastructure, especially limited technical support. Training is one element of computing infrastructure that receives continuing professional attention. But computing infrastructure refers to a much richer array of resources and practices and is a central element of *web models of computing* (Kling and Scacchi, 1982; Kling, 1987; Kling, 1992).

It is common for images of simplification to dominate talk about computerization, regardless of the complexity of systems. Clement (1990) reports a case of computerization for secretaries in which managers characterized new systems as "super typewriters" that did not require special training. They were very much mistaken. Many of the popular "full featured" PC software packages for text processing, spreadsheets, and databases include hundreds of features. Narratives that focus on the capabilities of systems usually suggest that people can readily have all the advantages that the features offer. Actual behavior often differs from these expectations. The majority of people who use these powerful programs learn only a small fraction of the available capabilities -- enough to do their most immediate work. Moreover, it is increasingly common for many workers to use multiple computer systems, often with conflicting conventions, further complicating people's ability to "use computer systems to their fullest advantage." This dilemma can be partially resolved through the adoption of comparatively uncomplicated systems. Providing staff training and having available consultants can increase the practicality of the system. But organizations that try to keep "overhead costs" low often seem more willing to buy new computer systems than to invest in internal training and consulting. Managers often decide that supporting computer use with training and consulting is too expensive. Training is not cheap; an organization may pay \$500 in labor time for a professional to learn to use a package that costs \$150 to purchase.

One of the authors vividly remembers a research administrator of a major food processing firm who was using a popular and powerful spreadsheet for budget projects. He wanted to print out reports in different fonts, such as printing budget categories in larger bolder print. But he did not

¹⁷ Their conception differs from that of Shulman, Penman and Sless (1990) who rigidly distinguish between the "technical infrastructure" in an organization and the "human infrastructure" and neglect interdependencies.

know how to do this. He believed that "it could be done easily" because he saw such a report in an advertisement. And, most important, he treated his ignorance as a personal failing. However, he would have had to learn his spreadsheet's macro facility to print in varied fonts. His manual provided no clues about the techniques for changing fonts within a report. In some organizations he might have turned to an information center with skilled consultants. In this company, the PC consultants were overworked installing new PCs and had no time to train the men or women who use them or consult with them on software use. This was not a critical problem for the manager. But it indicates how many organizations expect white collar workers to learn to effectively use computer systems on their own, with little support besides limited manuals and advice from co-workers. Windowing systems are another complex family of environments whose actual use has many nuances. They are sold as easy to use, while they actually daunt non-specialists who try to configure them without expert help. Computer systems do not work perfectly, further adding to the skills people need to develop and complicating their work (see Kling and Scacchi, 1982; Gasser, 1986; Jewett and Kling, 1990).

Christine Bullen and John Bennett (1991) examined how people actually integrate computer systems to support collaborative work in groups (groupware) into their work. They report how several work groups attempted to use some of today's best commercially available groupware systems with mixed results. Their informants found the value of the electronic mail features of these systems to be significant, despite the fact that a number of the electronic mail features were not used to full advantage. Others found many of the offered features hard to use, or not worth the effort (Also see Grudin, 1989).

Notably, Bullen and Bennett discovered that many groups eventually reorganized their work to take the best advantage of their groupware. For example, the usage of electronic calendars to schedule meetings requires that all participants keep detailed calendars up to date on the computer system, even if they spend much of their time out of the office. Many managers and professionals hope that they can computerize effectively by installing appropriate equipment, rather than by reorganizing work when they (re)computerize. Bullen and Bennett make a provocative attempt to characterize high performing groups and found that they are not always the most computerized. They argue that group members and their managers have worked hard to create work environments that have "clear elevating goals," and which support and reward commitment. These groups have developed effective social systems with coherent goals and related rewards as well as adopting technologies that might help improve their performance.

There is considerable unpublished controversy about this kind of analysis, since many technologists and computer vendors try to convince computer using organizations that appropriate new technologies alone will improve working styles and organizational effectiveness. During the 1990s interesting technologies such as expert systems, groupware and graphical interfaces will be written about by technologists and journalists as if they can significantly improve the ways that people work without requiring important changes in the way groups organize their work. Careful studies of work with new computing technologies, like Bullen and Bennett's study, suggest that new technologies alone are unlikely to be magic potions that can automatically improve work just by appearing in a workplace. (Also see Jewett and Kling, 1990).

8.0 CONCLUSIONS

In this chapter, we have examined several ways in which researchers and practitioners can advance their understanding of computerized and networked work life. First, we have examined the social design of computer and communications systems to help indicate how technologies are shaped by organizations as part of a computerization effort. The consequences of computing or networking for work organization and workers are byproducts of socio-technical configurations, or social designs, rather than of technology alone. The remainder of our article builds on this key point. Scholars and professionals who examine the usability and consequences of computerized systems rely upon specific conceptions of new information technologies and their relationships to organizational changes. We have examined four common conceptual models of organizational behavior which inform these analyses: combinations of Rational and Natural, and Open and Closed systems.

Second, we have conceptually integrated the analysis of work places that employ more "traditional" computing arrangements (i.e., central computing facilities or stand-alone PCs) and those that use computerized networks and communication systems. Most empirical studies of work with networks tend to focus on actions of the communicants, without examining the broader ecology of the organizational settings in which the systems function, and in which people who do not directly use the networks may control key resources for acquiring, regulating, and supporting system use.

Third, we have located the study of computerization and work life within an explicit set of models drawn from sociological theories of organization. The connection between the two topics is an important one. Organizational theory, by itself, rarely examines the dynamics of work. Studies of work life, on the other hand, seldom study the dynamics of organizations in which the work is done. A few studies link these "macro" and "micro" views of behavior in organizations, but the two levels of analysis should be combined in much more synergistic ways in future research.

We have focused on the tacit conceptions of organizational behavior that permeate much of the literature on computing and work life. Analyses which rely on Closed Rational systems assumptions dominate the professional literature and are common in the scholarly literature. Closed Rational systems models are relatively simple and easiest to write about and comprehend. As each new technology enters the marketplace, its advocates tend to write about its virtues in ways that presume that organizations act as Rational systems, and usually as Closed Rational systems. Advocates of emerging technologies, including some computer scientists, technical journalists, and consultants, try to characterize them as "so fundamentally different" from their precursors that one cannot learn from our previous experiences of computerization to understand some of their important uses, roles and consequences. We differ with this view, and have tried to show how we can learn to think about emerging technologies which are located in organizations whose behavior is better understood with richer models.

Closed Rational systems models can be unduly narrow, and even misleading. They often exclude important conditions that affect the roles of computer systems and their users. For example, they assume that all organizations adopt particular computer systems because of their value for expediting certain tasks. They ignore the possibility that some participants convince upper

managers to adopt computer technologies because of other considerations, such as image, helping to attract highly qualified technical staff, etc. For practitioners, Closed Rational systems models are troublesome because they are likely to underestimate the complexity of implementing and using computers and networks. And they emphasize only a limited range of values on which to base computer system design decisions.

We have found that the Open Systems models, both rational and natural, help us to understand the incentives that people have for using computing and network systems, in ways that are much more "true-to-life" than the Closed System models. Many issues of coordination in work lead people to interact with others outside of their immediate organizational unit. Consequently studies of coordination, work and computerization should rest on Open Systems models. Further, the Open Natural System models also provide important explanations for many of the opportunities and problems that are encountered in systems implementation and use, and can help us to better predict the actual value of these systems.

To summarize the comparative explanatory power of the four families of models, we return to the case of telecommuting. An analyst using Closed Rational Systems models of organizational behavior would examine telecommuting in terms of the tasks, social relationships, and efficiencies within the work group. But this perspective would have trouble accounting for social relationships between work group members and those outside of their organization. Rational Open Systems models could include relationships between employees working at dispersed geographic locations --including in the home -- and people in other organizations with whom they work. But we would still focus only on their work tasks. We would ignore other important social relationships that make homes into distinctive kinds of work places, not simply remote spaces that are free of distractions. By moving to an Open Natural view, we are able to assess the interactions between the employee, the work tasks, and all of the social actors and their demands -- such as children, neighbors, and other family members -- that make up the social ecology of the telecommuter.

The Open Natural systems models provide a sounder conceptual foundation for understanding diverse forms of work with computing and networks. They also assist us in identifying appropriate boundaries for the social design of systems. In designing a telecommuting work system, for example, these boundaries should include the non-task-oriented social actors as well as the computing equipment and network software.

Conceptions of organizations which rest on Rational systems models predominate in our technological communities. However, they are not scientifically sound ways to understand the changing worlds of work as they are supported and constrained by new technologies. Organizational theorists moved beyond Rational systems models by the 1930s. It's important for those who socially design computer and networked systems to think with organizational models that are as contemporary as the technologies which they wish to understand and use!

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