

7 The Impacts of Computer-Mediated Organizational and Interpersonnel Communication

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INTRODUCTION

With the emergence of computer-mediated information processing and communication, strong prophecies have been voiced about their implications for individual, institutional, legal, economic, and cultural effects. Wild information-based utopias, in which no one has to travel to work, are pitted against nightmares of corporate-controlled electronic surveillance and wholesale extermination of privacy (GOTLIEB & BORODIN; LAUDON, 1974; LAUDON, 1977; MADDOX; MARTIN; MOWSHOWITZ, 1976; PARKER, 1976; PYLYSHYN; REED; WEIZENBAUM; M. R. WESSEL; WINNER). The extremes may be just that—possibilities but not probabilities given the forces in society. MOWSHOWITZ (1979) describes the positions usually taken about new computer-based technologies. They are categorized according to whether or not one: 1) assumes that technological determinism or social forces rule; 2) supports regulation or free market mechanisms; or 3) favors the technologies.

One significant theory is that institutional change may be effected most easily during times of technological change (PARKER, 1976) and general intensification of demands on our environment and its natural resources. Indeed, THOMPSON, in an exceedingly thought-provoking report, PARKER (1978), and BRANSCOMB all argue that the implications of developing information resources far exceed those of optimizing energy resources. HARDY (p125), in an important and potentially influential analysis, proves that the advancement of "productive knowledge does make a contribution to economic growth. . . . Applications of this knowledge can be fostered through communication media." The significance of the new computer-based media is underscored by the fact that countries such as the United States and Japan are becoming information societies, with their economies increasingly based on the creation, manipulation, and transfer of information rather than goods, foods, or services (DRUCKER). That is, about 52% of the U.S. gross national product is now related to information. Major recent works describing this

transformation are by DRUCKER, MACHLUP, and PORAT (1976; 1980). Of course, information technology is only one dimension of production, and many information activities are not strictly productive. Moreover, TOMITA provides a moderating insight by arguing that in Japan only 10% of the information produced is actually consumed.

The development and implications of an information society, including the effects of new computer-mediated information- and communication-managing technologies, are of special interest to information scientists. PRICE argues that due to technological developments and rising costs of material-based transmission media, some complex, computer-mediated telecommunications media are obliterating the distinction between "information" and "communication." Moreover, PAISLEY, in a useful and creative overview of what we know about information work, argues that the distinctions between information work, service work, and production work are largely disappearing. The interaction of issues in information science, information retrieval, and public access to information are well considered by INTERNATIONAL WORD PROCESSING ASSOCIATION and A. E. WESSEL. The forthcoming legislative debate on library and information services (BENTON) will concentrate on their changing role. The debate will consider the development of a national information policy that encourages the interconnection of networks and the participation of telecommunications to provide services to homes, businesses, agencies, and libraries of all types. Thus, information scientists, communication researchers, policy makers, and organizational users all have a stake in the outcome of these issues.

This chapter reviews the effects of computer-mediated communication in a few areas of particular interest to information scientists, communication researchers, and policy makers—i.e., information exchange and communication as mediated by organizational information and word-processing systems and computer conferencing. Empirical research may indicate the usefulness and likelihood of some of the prophecies about the effects of computer-mediated communication and may indicate how easily various technologies can be redirected to fit chosen, informed policies during these times of technological and institutional change. For example, an interest in development theory and empirical analysis of the effects of a new telecommunications medium motivated research by RICE & PARKER that could alter engineering designs and national uses of communications satellites.

Unfortunately, all too often people, rather than technologies, are forced to adapt, while prior legal and economic structures are imposed onto new and changing technologies. Equally important is the fact that, as ANDERSON ET AL. revealed in field and laboratory studies, many people are seriously misinformed about what computers can do. In various treatments, 33% of the subjects (a thorough sample of secondary students and teachers) blamed themselves for malfunctions that were actually planned by the experimenters. Only an understanding of actual computer applications and effects could reduce the "mystique" that the subjects held and that intensified after the malfunctions. Infrequent users could be dominated by a growing elite who are knowledgeable about computers and information.

Japan firmly believes in the significance of the rise of an information society and has initiated some of the earliest and most sophisticated research (well represented by EDELSTEIN ET AL.) on its social implications (e.g., relative information deprivation among nearby communities and the effects of telecommunications infrastructure on the quality of life). Other authors specifically suggesting useful research goals and methods appropriate to topics reviewed here include ELLIS and LEAVENWORTH (organizational systems simulation), CARTER, CONRATH (1978; 1980), LOWENSTEIN, OLSON & WHITE (organizational media use and communication—LOWENSTEIN is the single best guide to designing and studying the effects of organizational computer-mediated communication technology), BAILEY ET AL., JOHANSEN, and JOHANSEN ET AL. (1979) (for research designs and variables in conferencing research). Variables that appear to provide considerable insight into the topics discussed below are rarely integrated in multivariate modeling, but potential breakthroughs are suggested by LINDSEY (who provides a model that relates variables on the group and organizational level) and PYE & YOUNG (who have developed methods to predict current and new media use). PAISLEY presents a literate and comprehensive review of the historical context, properties, individual factors, social factors, and issues in information work. DORDICK & GOLDMAN, JOHNSON & RIESING, MANN & WILLIAMS, and KEEN & MORTON offer case studies in, and developing frameworks for, analyzing the organizational process involved in adopting decision and communication systems. In general the problem of how to introduce the changes that accompany new systems into groups and organizations needs more research. Indeed, STRASSMAN emphasizes that much "information revolution" activity is misplaced; it concentrates on labor-intensive and wasteful information-handling processes (particularly in bureaucracies) rather than on an attempt to understand the transition to office environments. He argues that this transition should involve the reduction of interorganizational information flow and a redefinition of the economics of information.

The most consequential research may involve forecasting and assessing impacts from systems that are still in the conceptual stages—when their fundamental aspects can still be altered (HILTZ, 1980). Information scientists and communication researchers have considerable experience in research that is related to many of the issues in computer-mediated communication. Informed members of organizations, the telecommunications industries, and engineering professions are calling for such support. Information scientists are beginning to work in such environments and will have a self-interest as well as a scientific responsibility in furthering our understanding of the effects of using these new information-exchange and communication media.

ORGANIZATIONAL CONTEXTS

Research on the effects of information systems and "automated offices" in organizational contexts concentrates on two main areas: employee worklife

and organizational structure. Related research is interested in the innovation processes of adopting computers and the social utility of public management-information systems. However, organizational researchers have yet to place sufficient emphasis on the nature of information flows and the design of information technology itself. For good introductions to organizational tasks that are being computerized, their environments, and the developing technologies see KEEN & MORTON and UHLIG ET AL.

Impact on Organizational Worklife

Early empirical studies, such as those by HOOS, revealed widely variable effects. The first major study (WHISLER, 1970b) concluded that the arrival of the computer apparently enriched the managers' jobs but constrained the clerks' jobs: decision making moved upstairs (at least from the lower levels), and the number of subordinates controlled by lower-level managers decreased. (MANN & WILLIAMS, in a subjective case study, replicated these results.) However, the study's use of measures with only binary values (e.g., presence or absence of computer) and data gathered from only one manager in each insurance company may have accentuated these differences.

KLING (1979a), in analyzing 1976 data from 1,200 respondents working in six information-processing tasks (e.g., processing traffic tickets) in 42 municipal governments, found less clearcut results. For most variables, "no change" was the most frequent response of the subjects questioned after computers were introduced into their organization. However, there was a fair amount of perceived increase in task significance, dealing with others, feedback, and skill variety. (These results are similar to those of studies cited by GOTLIEB & BORODIN, Chapter 9.) The closeness of supervision did not appear to change, and respondents were evenly divided in perceiving increased or lessened pressure (except, of course, that data analysts felt more pressure). The magnitude of perception by respondents of the effects of computers generally increased as their dependence on the computer increased. Kling concluded that the effects were subtle and not revolutionary: the computer is gradually integrated into normal business, particularly when computer-mediated technology is simply substituted for previous ways of doing the same job.

An international study of eight organizations in five countries (ROBEY, 1979) was motivated by an expectancy model: effects or motivations are functions of perceived rewards. Thus, a respondent would be likely to evaluate positively any increased task routinization because tasks could be controlled better, performance would be improved, and the expectancy of reward would be heightened. On Robey's thoughtful questionnaire, respondents *favorably* reported:

- Increased number of problems recognized, possibility of new ideas or methods, and decision feedback;
- Increased task routinization, although they were less favorable (50%) to increased standardization; and
- Increased work pace and load, yet they were evenly divided about the favorability of the increased variability of the pace.

Most users attributed positive job results to the organization's use of a computer system even though the character of their work did not really change much. LAWREY ET AL. interviewed bank tellers several times before and after they began using terminals in their work. There were few changes in psychological or behavioral measures except for a more positive attitude toward co-workers and personal responsibility for quality in their work; these changes increased somewhat over time. (The Hawthorne effect—increased satisfaction or production due to the simple fact of visible change in an organization—may be operating here.)

WILKERSON interviewed 25 managers and secretaries, from various functional areas, who had used (in an environment that supported computer use) a corporate electronic mail system from three to eight months. In general, the major effect was that most users (particularly secretaries) were highly satisfied with and relied heavily on the system, largely because of its speed and asynchronous communication capabilities. Individuals who were directly linked via the system to a higher proportion of functional partners (particularly secretaries and their managers) tended to evaluate the system more positively. Managers felt that this system increased the speed of decision making and allowed more upward communication. As in the analysis of SRI (see below) by BAIR (1979a; 1979b), users estimated that they saved seven to ten hours a week with the system. This time was often then used for more creative and challenging work. GREENWOOD & FARMER, testing the effects of a word-processing and electronic mail system in a circuit court, found considerable time savings in preparing and signing opinions but no related disruptions in organizational relationships or work styles. They did not, however, discuss the effect on perceived quality of decisions, a significant issue in such an organization.

The kinds of payoffs that BAIR (1979a; 1979b) CARLISLE, CONRATH & BAIR, STANFORD UNIVERSITY, and UHLIG foresee and find include: 1) fewer kinds and numbers of transformations of information between media (e.g., from a memo to a telephone call to a letter); 2) less nonproductive functions, such as redialing busy telephone numbers; 3) automation of manual processes (although the number of revisions in text editing usually increases by a factor of 3); 4) improved scheduling; 5) reduction of repetitious work; 6) fewer delays in preparation; 7) higher writing quality; and 8) increased control of needed information.

Some of these studies claim that there have been no negative consequences (BAIR, 1979b) and that therefore their favorable cost-benefit analyses are sufficient justification for full use. Perhaps the respondents were too close to the change or the environments were atypically supportive, but these studies did not find some disadvantages that were reported by others. For example, UHLIG and WILKERSON both noted that the nonverbal cues lost by the use of computer-mediated communication, the general decrease of managerial face-to-face communication, and the increased rapidity of response sometimes led to iterative escalations of misunderstandings. In some cases total communication increased; this increased information at times overwhelmed the natural gatekeeping (information-filtering) processes in an organization and created overload or redundancy at higher levels (STANFORD UNIVERSITY;

WILKERSON). As several information researchers emphasize, an increase in the amount or flow of information may have no (or negative) relation to the desired organizational functions of the users; and understanding may be masked by torrents of input (LIPINSKI ET AL.). MANN & WILLIAMS and WHISLER (1970b) discovered that although overall interpersonal communication increased during the developmental stages of new systems, it declined after the systems were installed and refined.

Impact on Employment

The controversy over the impact of computerized (particularly word-processing) systems on employment is intense. Some argue that although certain positions are vulnerable, in general more of certain white collar positions become available. WHISLER (1970b) found that the number of clerical positions declined in the organizations he studied. OLSON & WHITE noted a 53% decrease in stenographers' positions between 1960 and 1970 but a 90-140% increase in the number of file clerks, tellers, and secretaries in the same period. Indeed, the number of estimated unfilled secretarial positions is estimated to rise to 250,000 in 1980 (STANFORD UNIVERSITY). Even increases in the absolute number of middle-level managers in organizations that were adopting systems were reported by BLAU ET AL.

Of the eight largest private employers, five are information intensive (AT&T, GE, GTE, IBM, and ITT) although some have been reducing their labor forces. The 50 largest banks—major information processors—increased their employment from 369,000 in 1970 to 515,000 in 1979, while the industrial giants barely increased employment in the same period. The most comprehensive review of this issue as of 1965 is that by JAFFE & FROOMKIN. In an update, GOTLIEB & BORODIN (p171) concluded that computers slightly reduce the overall growth of employment (partly through increased productivity), particularly for automated tasks where increased output does not require more labor. They write: "Some studies have revealed that there were reductions in staff (even during periods of business growth) . . . but this has distinctly not been the usual case."

The growing practice of task pools supported by word-processing systems may dramatically alter the types of jobs performed by personal secretaries and middle-level managers as well as their roles and status. Some secretarial positions may require less typing and may become entry-level management jobs (WHITE). This may be an explanation for the otherwise contradictory results reported by the INTERNATIONAL WORD PROCESSING ASSOCIATION, which surveyed over 1,000 managers and executives concerning employment in the word-processing field. It noted that although the average size of word-processing staffs increased from 8 to 14 in the past 6 years, nearly 40% of those surveyed indicated general secretarial staff reductions due to greater efficiency, reduced work load, etc. Other employees may lose the status of working closely with a particular executive (STANFORD UNIVERSITY). Upward mobility or competence in computing jobs may be restricted to the highly educated.

The threat of job displacement by computer systems is sometimes very real: 90% of the 32 companies analyzed in one study noted by SANDERS

reduced the number of their employees or found that more work could be done by the same number of employees because of computerized systems. Thousands of positions were eliminated in one insurance company. Ratios of professional to clerical personnel have been increased in some computer-intensive organizations (STANFORD UNIVERSITY). Some European unions are particularly pessimistic, predicting massive additional unemployment caused by computerized automation by the year 2000. EUROPEAN TRADE UNION INSTITUTE and TRADES UNION CONGRESS have prepared thoughtful reports on the implications of computer-mediated communications technology for European unions and will include specific proposals in their upcoming negotiations in such industries. In general, their forecasts and proposals show reasonable concern but are not extremely pessimistic. There seems to be considerable fear, however, that computerization will displace many jobs; the question is whether and how societies can generate other jobs (HILTZ, 1980).

Impact on Organizational Structure

(De)centralization. Whether the introduction and use of computers cause organizational centralization (the control of information flow, resources, and decision making by higher management or company headquarters) or decentralization is a frequent and significant concern. This section reviews research on this concern and notes some of the useful variables so that: 1) we have a sense of the effects of computer use on organizational structure, and 2) meaningful variables can be integrated into future research. Unfortunately, the measures in many studies are simplistic or vary in definition across studies.

Some studies essentially consider only the presence or absence of types of structural change. For example, TRICKER briefly noted two studies that showed little effect of computerization on structure or decision making (except tightening of operational control) and two others that indicated increased structure and expansion of middle management along with more control at the top. ROBEY (1979), introducing additional variables (such as computer function and task context) into his study, found structural change in only three of eight organizations. He suggested that the results indicated that the impact of management information systems varies according to their function in a particular setting. PAISLEY's taxonomy and analysis of tasks involved in information work convince us why it should not be surprising that the particular task or function of the implemented computer system is an important variable. In general, Robey does not support a notion of tendencies toward centralization, disagreeing with MOWSHOWITZ (1976), MUMFORD & BANKS and WHISLER (1970b), who found evidence of increased centralization of control and decreased individual skill and control. However, the review by Robey associates the advent of computers "unequivocally" with greater horizontal differentiation, which allows units to expand control at a given level yet reduces the possibility of informal decisions across units.

The environment and (de)centralization. Much recent research has groped for more complex models and theoretical contexts of structural effects. An

earlier paper by ROBEY (1977) looked at a possible mediating factor: the stability of the organization's environment. Taking an environmental/systems perspective, he implied that organizations in a stable environment will tend to centralize in any event, but a complex or unstable environment will require looser or decentralized organizations; thus, computer effects may be moderated by the environment or may not even be significant. In this context Robey reviewed earlier studies (DELEHARTY; GALLAGHER; REIF; SIEGMAN & KARSH; STEWART, 1972; WAGNER), which reported that many organizations, such as electric utilities, airline reservation divisions, state civil service bureaus, and life insurance companies, either increased the centralization of authority or accounting functions or were already highly centralized and remained so. Based on information in the original papers, Robey suggests that all these organizational environments were stable because of a known demand, simple industry structure, or the lesser demands on a one-service company. Therefore, new computer systems allowed the organizational structure to change to one more suited to its environment.

In unstable environments (e.g., those involving organizational expansion, complex markets, large-scale industries in competitive markets) the cases in general revealed little effect on structure except for tighter discipline and scheduling for data input, reduced human intervention in some activities, and somewhat increased distribution of decision-making power to regional areas. ROBEY (1977) does mention the study by KLATZKY of 53 state employment agencies. This study found an association between greater computer use and increased decentralization, in what could be considered fairly stable environments, but Robey discounts these apparently contradictory results by criticizing Klatzky's measures of computer use (number of computers and input/output units used) and the lack of connection between the decisions evaluated for decentralization and the actual computer uses. However, as noted below, there seem to be significant differences between computer use in private vs. public organizations.

ROBEY (1979) concludes that: 1) computers do not cause changes in amounts of delegation, 2) the degree of centralization is determined mainly by environmental conditions of the organizations, and 3) computer systems are flexible enough to facilitate (or be blamed for) all kinds of planned structural change. WITHINGTON supports such conclusions, noting that greater centralized control occurred only in areas with routine tasks. BLAU ET AL. agree, using an exceptionally diverse and well-operationalized set of measures (e.g., size of personnel component, span of control, decentralization of decision making, differentiation, mechanization, and size). They found that organizational size was the variable that correlated most strongly with structural change, and they reject any notion of straightforward technological determinism. However, decision making became more centralized when branches and divisions used time-sharing systems located at corporate headquarters or outside firms.

Research on computer impacts could be significantly informed by consideration of such environmental contexts. ALDRICH and LAWRENCE & LORSCH provide rich theoretical foundations for explaining why environ-

mental stability (and other dimensions) should affect organizational structure and survival. The effects of computer use can be influenced or determined by the environment in which the organization operates. It is also probable that effects can arise from the way in which computer use alters the relationship between an organization and its environment.

Communication and (de)centralization. As suggested by several organizational network analysts (CONRATH, 1973; CONRATH, 1978; RICE & RICHARDS; ROGERS & AGARWALA-ROGERS), organizational structure can be considered as a set of communication networks. For example, executives spend more time making decisions and giving orders in centralized rather than decentralized organizations. In addition, the primary product of managers (and information scientists) is information, which gains value as it is mentally and interpersonally processed and transferred along formal and social networks within the organization. Thus, communication technologies (and management policies) can affect structure, particularly when they affect tasks that involve which individuals relate with one another and how.

The effects of word-processing systems, computerized conferencing (CC), and "automated offices" are evaluated favorably from this perspective in several papers by BAIR (1979a; 1979b), CARLISLE, CONRATH & BAIR, and UHLIG. The basic premise of the authors is that the potential benefits of "automated offices" are greatest for professional and managerial tasks, of which 75% involve communication (mostly oral and in meetings). For the most recent and comprehensive reviews since STEWART (1967; 1976) and MINTZBERG of how managers allocate their time, media use, and tasks, see CARTER and PYE & YOUNG, who argue that these allocations and information flows must be known and analyzed in order for one to design useful systems with desirable effects.

In the study of an Air Force section's use of Stanford Research Institute's (SRI) OnLineSystem (NLS) (now Tymshare's Augment Service) the greatest organizational changes occurred in the users' communication patterns—increased connectivity and effectiveness. At SRI itself, subjective analysis of four-years' use of NLS concluded that individual effectiveness, team consensus, intraorganizational collaboration, and overall communication increased, and nearly 2 hours a day were saved by a typical professional in an environment that admittedly supports information augmentation. Other general findings were: a preference for using NLS for upward-flowing messages (bridging authority levels), and increased breadth of contact. Bell Canada's use of NLS resulted in better project-oriented communication and greater external links, but there was little improvement in problem solving; other results are similar to SRI's (LEDUC).

PRICE refers to a study in which a computer-messaging system dramatically altered the structure of a widely dispersed information-intensive consulting and computer company. The very strong democratizing and flexible communication system allowed/required a shift from a hierarchical organization to one consisting mostly of constantly changing teams. INFOMEDIA CORPORATION and other organizations (STANFORD UNIVERSITY) claim that the use of a messaging system allows management to increase its span of

control. In addition, Infomedia Corp. indicates that the accompanying greater access to information can also decentralize responsibility and decrease the status of those who traditionally control information flow. However, another investigation suggested that neither the number of those involved in decision making nor decentralization necessarily increases with the organizational use of this medium (JOHANSEN ET AL., 1978).

Decision level and adoption process. In the organizations studied by MANN & WILLIAMS and WHISLER (1970a, p93), decision making became more quantified and rationalized; in general the "use of computers in decision making stimulates ideas for change but greatly increases the costs of adopting these changes." Using a much wider definition of centralization (including dependence on authority, formalization, commitment to organizational goals, accountability, and enforcement), TRICKER argues that the impact of information systems depends on an interaction among: 1) the type of system, 2) the particular task involved, 3) management policy, and 4) existing organizational structure. For example, at low decision levels, information is often discrete, repetitive, certain, and part of a transaction. At high levels, decisions are strategic and are often based on unpredictable, complex, and risky information. Clearly, changes in information processing and communication procedures would have different effects at each level. This may explain why BLAU ET AL. discovered increased span of control by section-level managers, decreased span at the lowest levels (as did WHISLER, 1970b) and no change at divisional levels.

Concerning the adoption process, BARTEZZAGHI & MAGGIOLINI suggest that the stage of computerization (from initiation and assimilation of computer technology through the integration of database technology into the organization) significantly affects the type and scope of its effects. Using data from 18 organizations, they show that one of the prime structural changes is the creation of the data-processing unit itself, along with where the unit will report. That is, power can be reallocated after computer implementation, depending on the stage of computerization and initial management decisions. In some cases, the computer group itself becomes more influential in solving problems and influencing future objectives and plans (WHISLER, 1970a). MANN & WILLIAMS, as well as MYERS and many other researchers, provide considerable subjective insight in recounting case histories of computer adoption and implementation.

Not only may some of the justifications of management-information systems (such as increased productivity) often be short lived (SCACCHI), but their actual effect will depend on organizational contexts and even individual choice. Computing impacts vary within and across job types (KLING, 1979a), partly because of different habits, preferences, and styles of communication among job types or even academic departments (STANFORD UNIVERSITY). STEWART (1972) emphasized that in the short run, human behavior is constrained by new systems but that eventually people do have considerable choice [e.g., they may incorporate the system, sabotage it (see GOTLIEB & BORODIN, p183, and SANDERS) or "reinvent" it for their own purposes (RICE & ROGERS)]. Social systems take time to adjust to technological sys-

terms but may eventually exploit the systems and even the act of introducing new technology.

Geographic decentralization. The final form of structural change considered—external decentralization of an organization and its workers—has enormous implications in a world of decreasing energy resources and urban services. Computerized conferencing (CC) and information systems can facilitate this decentralization. A series of experiments by the New Rural Society Project (KOHL ET AL.) measured internal and external communication needs and processes to identify organizational components that could be shifted to rural areas. The general conclusion was that telecommunications could facilitate decentralization for the types of tasks and meetings found appropriate for CC as described below—i.e., routine or information-transfer tasks. NILLES offers similar conclusions, based on theoretical cost analyses, but he warns that the advent of external decentralization must be accompanied by telecommunication design innovations and training for new and old workers, as well as by a reevaluation of union constraints and right-to-work laws.

The issue of external decentralization is a complex subset of the debates on the tradeoffs among telecommunications, transportation, and energy (HILEWICK; MITRE CORPORATION; OVERBY ET AL.; POLISHUK). NILLES ET AL. comprehensively discuss the costs, methods, experiments, issues, and implications of such tradeoffs, and they favor greater consideration of substituting telecommunications for transportation. With rising energy costs, investments in telecommunications rather than in transportation will be more common. PELTON shows, for example, that new transportation facilities have larger short-term economic effects (although the effects are more centralized and concentrated) but that the magnitude of multiplier effects for communications investment is greater, longer lasting, and significantly different from that of transportation or other traditional investments. However, predictions of mass exodus from urban areas by workers who will set up cottage industries by means of extensive telecommunications facilities do not find enthusiastic support in these studies.

Public Administration

The selected research results on computers in the public administration setting are depressing. DUTTON & KRAEMER (1978) and DANZINGER & DUTTON agree that little of the variability in computer adoption and system use can be explained by "need," system sophistication, or control over computing decisions. The political order, outside funding, management support, and the various influences that an adopter faces are potent forces. These results support claims by LAUDON (1974; 1977) that municipal computer systems are largely political instruments; often they only increase an administration's attractiveness or its ability to provide showy reports (KLING, 1979b). Worse, in one study (KLING, 1978a) the reports produced by these systems failed to lead to either an awareness or understanding of the previously unknown city conditions (discussed in the reports) 90% of the time. One-

third of the time, the reports were used to lend legitimacy to prior decisions. However, nearly half of the municipal leaders surveyed and interviewed by DUTTON & KRAEMER (1978) received computer-generated reports or information, and most perceived an increase in decision-making benefits, although less in areas of operational performance, control, or reductions in staff and costs.

Even when computer systems are used for their stated purpose, the methodological biases built into budgeting and simulation programs (and thus the policy decisions based on the output) in local government are numerous (ROBEY, 1979). DUTTON & KRAEMER (1980) skillfully describe the increasing pervasiveness of public information systems that have the bias of designers and politicians built (often unknowingly) into the software and even into the data-gathering process. KLING (1978b) reported that few welfare agencies took part in a large welfare client-tracking and information/service system, largely because of the terse, statistical nature of the system and the desire by agencies to protect their territorial imperatives. Some systems are used only to regulate and to track clients rather than to expand social services to current and new clients.

Perhaps the most paradoxical findings of studies about computer use by public institutions, reported by KING & KRAEMER in a study of 42 U.S. cities and 16 cities in other developed nations, were that policies initiated to *reduce* problems involved with computer use were associated with *increased* problems. Increases in computer problems were also associated with the formation of policy boards and committees that were convened to solve the initial problems, with highly sophisticated systems, with extensive user involvement and training, and with the later stages of adoption. Either the policies that were developed to solve the problems were simply failures, or "problems arise to meet the threat of policies." KLING (1978c) suggests that organizational obstacles such as the drive to maintain former behavior and departmental competition largely prevent the good use of information systems in public policy making.

WORTHLEY, in a review of several books on computers in public settings, reports a fair amount of aggravation by respondents [as does KLING (1979a)], which is often caused by inadequate design of software and human interfaces and by limited managerial understanding of computer resources. Systems in public (and many private) organizations are often viewed as origins of frustration and are rarely used as the relevant managerial or decision-making aids that they can be (ACKOFF; BONINI; DUTTON & KRAEMER, 1978).

Summary

Much organizational *research* does not support theories of strict technological determinism or severe worker alienation by computer systems. This is not to deny real links between the development and use of computer systems and political issues and effects (e.g., control, distribution, access, dependence, and values). Indeed, HOCHHEIMER reviews the use of computers in political contexts and laments the paucity of attention (empirical

and otherwise) paid to such issues and effects. As COLTON (p18) writes, in a thorough review of computer uses, impacts, and issues in police applications, computers do not "cause" centralization or decentralization but tend to "support or enhance established trends or direction of change." This body of research does not minimize, however, the wide, often unpredictable ramifications of computers in the work setting; WORTHLEY argues that users must treat this technology as the powerful resource that it is. Control or removal of some of the undesirable effects of computers in private organizations seems to be easily within the grasp of informed management policy in cooperation with employees and even consumers. For public institutions, most of the negative effects are clearly political, and their control may be possible only by the active interest of local citizens with the aid of information researchers.

COMPUTER CONFERENCING

The extensive and growing research on computer-mediated conferencing (CC) indicates the potential significance and fertile analytical environment of this new medium. Here, we review research on systems that primarily involve exchange and processing of text, with perhaps simple graphics, but not voice or video. HILTZ & TUROFF (1978a) wrote the major text on all aspects of CC, and JOHANSEN provided the best organized and most succinct review of teleconferencing media comparisons to date. (See HOUGH; JOHANSEN ET AL., 1979; PRICE; and especially LEDUC ET AL. for system descriptions and bibliographies, and *ELECTRONIC MAIL AND MESSAGE SYSTEMS NEWSLETTER* for a technical introduction.) RICE provides historical background, a description of CC operations, and more detail on research results than given here.

This section considers several areas of research on the use and effects of CC (satisfaction, frequency, and pattern style), comparisons with alternative media (participation, effects on group processes, appropriate uses) and substitutability (for other media and experiences). Matching the insufficient emphasis by organizational communication research on information flow and technical design, CC research generally overlooks the wider organizational impacts, and indeed much CC research is not conducted in formal organizations. Although such research is increasing, individuals, small groups, well-controlled experiments, and technical concerns are the main foci.

Usage: Acceptance

Hindered access to a terminal, unreliable telephone lines, lack of trust in other group members, or other activities with higher priority can be significant reasons for limited use of CC (HILTZ, 1978d; JOHANSEN ET AL., 1979; WILKERSON). Poor system reliability can lead to perceptions of decreased reliability of other tools used within a conference, to increased status of technically expert members, and to decreased emphasis on problem

solving (LIPINSKI ET AL.). A common objection—the necessity of typing skills (because most CC systems involve the typing of text on a hard-copy terminal or CRT (cathode ray tube) that is linked, via telephone lines and/or computer networks, to other terminals)—does not seem to be a major factor¹ (CHAPANIS; JOHANSEN ET AL., 1979), at least after the initial period. Apparently the user spends much time in non-typing activities or combines slow typing with mental composition. Other than access (which includes the exact location of terminals in an office), social and work relationships (which affect workflow) and contextual factors (e.g., conflict resolution and authority in an organizational setting) are the major determinants of CC acceptance (SHULMAN & STEINMAN).

Usage: Patterns

The communication and usage behaviors of CC participants vary with the extent of use, communication mode (private messaging, group conferencing), and timing of response (synchronous or asynchronous). HILTZ & TUROFF (1978a) find that there are stages in acquiring CC facility, from initial culture shock to learning new social cues and perhaps to addiction. The main point is that the communication modes are distinct (in various ways), and users alter their behavior with increased use of the modes.

Not surprisingly (but importantly) attitudes toward such systems change with increasing use of the systems: satisfaction increases, a sense of tediousness decreases, and impersonality of the work environment decreases (CONRATH & BAIR; HILTZ, 1978c; IRVING; JOHANSEN ET AL., 1978). Perhaps new users view CC as a simple substitute for familiar messaging media but develop an understanding that CC has its own advantages and constraints. For example, HILTZ & TUROFF (1980a) show that perceived usefulness of features that facilitate long-term group communication, active control and tailoring of the system, and composition increases as users develop new appreciation and uses for the medium. Users seem to need a "real" task to motivate them to use and to like CC. Perhaps related to the professional priorities mentioned earlier, this importance of a cohesive group task explains usage amount far more than do costs, system characteristics, typing speed, or prior computer experience (HILTZ, 1979).

An important policy implication here is that a computer-based message/conferencing system should allow (and be allowed, by regulatory policy, to provide) different modes of communication precisely because these modes receive demonstrably different emphasis by users. Implementors should also allow longitudinal development of system design because user behavior evolves and simple message systems become insufficient for regular, experienced users (HILTZ & TUROFF, 1980a). Indeed, if CC is seen only as a substitute for current media, constrictive regulations and applications might result.

¹ Personal interview with R. Miller, Vice President of Infomedie Corp., January 9, 1980.

Comparisons: Participation

As KOOMEN & SAGEL and many other group researchers find, participation in group discussions is naturally distributed unequally among the members. An individual has at least two stable personality traits that predict quite well his or her group participation: the delay in responding and the duration of response. However, CC avoids many of the visual social cues that trigger these traits and allows much more equal participation in group discussion. Thus, more reserved group members may finally gain access to discussions and decision making, while any individual may have a harder time gaining the group's attention. In fact, the emergence of group leaders is different and less likely in teleconferencing (WILLIAMS). This has implications for decision-oriented applications of teleconferencing because inequality of participation may be important for tasks that require coordination and direction by a leader. Specific forms of participation do have significant implications; for example, VALLEE analyzed a simulation that revealed significantly more within-group interaction for the winning coalition rather than the losing coalition. PAISLEY references studies that generally show that greater productivity (measured in various ways) is associated with greater and more diverse communication by the groups (depending on various conditions).

Comparisons: Direct Communication and Decision Tasks

Many opponents of CC emphasize the absence of nonverbal communication and social presence. Certainly CC does not allow cues for the sequencing of interactions, nonverbal feelings, intentions, and physical relationships. Immediate feedback is usually missing, and group or rhetorical questions often go unanswered. These losses can cause misunderstandings. However, conferencing that allows simultaneous interaction does allow immediate response, personal cues often appear in new forms, and direct questions are almost always answered, even when addressed to strangers. The absence of visual and nonverbal cues may be an advantage to users with visual or speech handicaps, those usually intimidated by taking turns, or those who appreciate the break from eye contact to compose a thoughtful response (HILTZ & TUROFF, 1978a; JOHANSEN). Face-to-face interaction does allow or provide increased bandwidth, types of information, questioning, interruption and digressions, and quicker adjustments to changes in interactions.

Much research has considered group-decision processes in a CC environment (HILTZ & TUROFF, 1978a). Using small groups with simple or complex group-decision tasks, researchers have attempted to compare the effects of different communication media (usually face to face and CC). In general, CC groups take longer to reach agreement (HILTZ, 1978a; 1979; JOHANSEN), perhaps because more time is spent in noncommunicative acts, fewer items are exchanged, group problems are injected into the task (HILTZ, 1978b), or a leader is less likely to emerge as quickly, if at all. There may be less consensus in CC groups for complex or human-relations tasks. For reasons of group coordination mentioned earlier, it seems that unstructured

problems require a strong leader, which CC suppresses somewhat. The comprehensive review and analysis by SHORT ET AL., although it does not involve CC, provides good evidence that the amount of "social presence"—i.e., how "real" the other person seems—that a particular medium allows, along with the extent to which a communication event involves interpersonal and task objectives, significantly affects the necessity for a group leader and the success of the group interaction.

Comparisons: Appropriate Applications

Using a typology of group activities developed by SHORT ET AL., researchers have arrived at similar conclusions about the appropriate (or at least positively evaluated) uses for CC. As Short et al. write (p109, 156), the outcome of meetings can be "significantly affected by the medium of communications used. . . . Some tasks are more sensitive than others." In general, CC is at least as good as and sometimes better than face-to-face contact (in some experiments, video contact) for the following tasks: 1) exchanging (especially technical) information (particularly in short bursts), 2) asking questions, 3) exchanging opinions or orders, 4) staying in touch, and 5) generating ideas. These interactions do not demand high personal involvement and are cooperative ventures. CC is not nearly as satisfactory as face-to-face or video communication for: 1) bargaining, 2) resolving disagreements, 3) getting to know someone, or 4) tasks requiring constant, focused discussion. However, for embarrassing interactions or those that involve conflict, CC may be the best medium precisely because it minimizes personal contact.

The earlier point about changing attitudes with increasing use holds here as well. New users generally rate face-to-face communication higher for all group processes or tasks, while experienced users develop the ability to discriminate the appropriate uses listed above. Also intriguing is that users feel more confident in their perceptions gained from face-to-face meetings than in those gained from media involving less nonverbal communication, but users are in fact no more accurate in their perceptions (and sometimes less accurate) when using face-to-face media than when using those other media (SHORT ET AL.).

Transferability, Substitutability, and New Uses

Can a CC system providing communication and information exchange for geographically dispersed researchers substitute for a centrally located institution or laboratory? Research indicates that such communication support can be successful. HILTZ & TUROFF (1978a) review an experiment involving energy researchers' use of conventional and CC interaction in alternating periods. CC facilitated more flexible working hours, increased colleague contact, more efficient use of other media, and more precise text. The Electronic Information Exchange System (EIES) project sponsored by the National Science Foundation (NSF) included participant surveys, which also indicated that respondents felt that CC increased their quality of work, variety of ideas,

and contact with the work of others (HILTZ, 1979). FREEMAN & FREEMAN and JOHANSEN ET AL. (1978; 1979) concluded that as researchers at different institutions increased the number of contacts with researchers from different disciplines, they evaluated their use of CC more positively. However, not all changes in communication patterns facilitated by CC are positive. FREEMAN & FREEMAN, using network analysis (see RICE & RICHARDS), studied a group of researchers who had used EIES for a year. All types of relationships (except "close friends") had more interconnections, communication via CC was remembered better than communication in several face-to-face meetings, and some people developed "close friendships" over EIES. However, inequalities in the strengths of "friend" and "close friend" bonds increased, and interdisciplinary collaboration tended to force members of each discipline into defined stances apart from other disciplines.

Some studies have considered how the introduction of a CC system affects activities or the use of other media in an organization. JOHANSEN ET AL. (1978) report slight decreases in mail and work-related reading but no decrease in telephone use (although CONRATH (1978) and WILKERSON found reductions). SRI's use of NLS—not explicitly a CC system—did result in increased total communication and reduced face-to-face and telephone contact but not written communication (CONRATH & BAIR). This type of change is also reported by EDWARDS, LEDUC, MCNURLIN, and STANFORD UNIVERSITY. WILLIAMS suggests that teleconferencing might provide a reasonable substitute for 50% of current face-to-face meetings, but much lower figures are suggested by others. For example, in analyzing communication flow characteristics, DORMOIS ET AL. concluded that only 7% of meetings and 14% of telephone uses could be transferred to teleconferencing. This exhaustive and sophisticated study involved 2,000 respondents and 33,000 interorganizational communications in 60 organizations.

Some new uses develop as well (CONRATH, 1978). For example, more than 50% of messages by the members of a United States-Canada communication satellite project using a CC system occurred when telephone usage would have been impractical (INFOMEDIA CORPORATION). These new uses create new communication behaviors and habits. When one can work at home by computer-mediated communication, what will become of the distinctions between work hours and leisure hours (JOHANSEN ET AL., 1978)? Preliminary experiences show that the transition between work and leisure activities can be difficult and frustrating to family members and neighbors (HILTZ, 1980).

CONCLUSION

This chapter has attempted to review and to summarize empirical research on the effects of computer-mediated communication/information exchange and management in several contexts. The effects of such systems on organizational work, employment, structure, and public institution applications indicate that an understanding of the technology, its functions, and the way

people live in organizations must be (and can be) incorporated into management decisions and planning to produce desirable results. The politics involved in using such systems (particularly in public institutions) are far more disheartening if not surprising. With CC the benefits seem fairly clear when appropriate applications are involved. Here, governmental support and research by information scientists have shown that we can obtain the positive effects that optimists predict but that this support must continue and must emphasize access and social applications.

Clearly, few of the long-range social effects prophesied by numerous authors (such as the replacement of intuitive judgment by technical reasoning which WEIZENBAUM claims) have yet to be empirically tested—perhaps they cannot be strictly tested—but some promising and necessary variables have been suggested and should be incorporated into future research. Theoretical bases, such as the implications of increasing division of labor and human ecology, also should be considered. It would be fruitful to determine just what it is that people do when they interact via computer; in organizations this is not a trivial problem, although in the uses of CC it may be more straightforward. The analyses by CARTER, the EIES evaluations (HILTZ & TUROFF, 1978a), and the services by INFOMEDIA CORPORATION are some of the few cases where research results on user behavior are used explicitly to guide computer-mediated technology design and use.

Economic and political forces will shape major legislation such as the currently debated Communications Act, which will replace the current laws and principles first formulated in 1934, and the upcoming legislation that will replace the Library Services and Construction Act, which expires in 1982. Policy makers and researchers should know that social research on the effects of computer-mediated communication does exist. Research should join politics and economics to shape our information society. Information scientists, industry, and government should cooperate to avoid unsupported notions about the effects of computer-mediated communications, socially inequitable and inflexible technology, or restrictive regulations and premature standardization.

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