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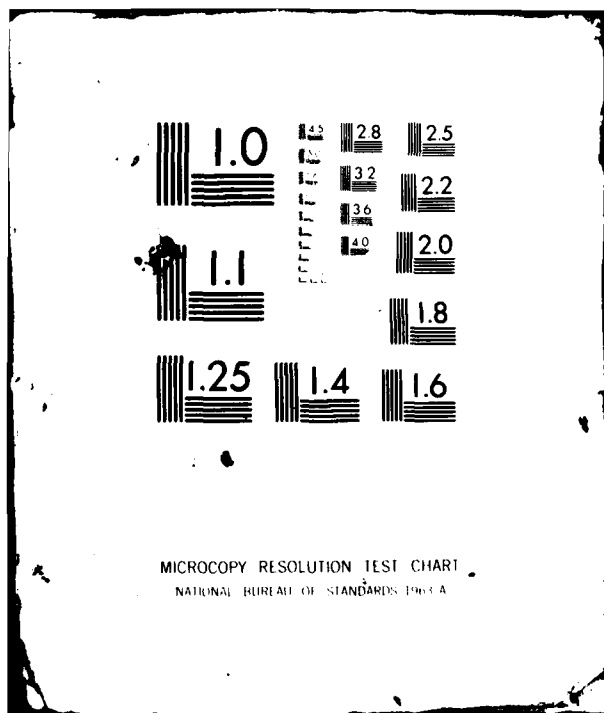
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EMERGING SOCIAL SCIENCE ISSUES

Tora K. Bikson, Ph.D.

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ELECTRONIC INFORMATION SYSTEMS AND USER CONTEXTS: EMERGING SOCIAL SCIENCE ISSUES

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Introduction. Computer technology, having advanced at a tremendous rate during the past 20 years, has already introduced electronic information systems into a substantial number and variety of public and private sector contexts. Of the estimated 3.5 million offices in the U.S., about 1.5 million are currently considered large enough for some form of electronic information system; and that figure can only increase as the production of minisystems permits smaller and smaller organizations to make efficient use of computers. The "Office of the Future" has thus been widely touted as the major change in work settings to be expected during the 1980s. At the National Bureau of Standard's conference on distributed processing, for example, it was noted that "most large corporations and government agencies are planning or implementing 'office of the future' systems." Such changes are expected to affect well over 50 percent of the total work force (Bair, 1978). Moreover, the search for more rapid error-free communication as well as the growing need to link information processing systems to large or remote databases and other equipment is creating a burgeoning demand for local networks. A new eight-year forecast from International Resource Development, Inc. (1981) predicts local networks will represent a \$3.2 billion market by 1990, even though only rudimentary short-range networks are presently available.

The introduction of electronic information systems in myriad user settings, then, comprises a trend of long-term national significance. Clearly alternative choices in the management of that process can have substantially different economic and social impacts. With the technological barriers to such change being rapidly eliminated, a number of issues emerge for social research.

Policy Issues. The policy issues, broadly construed, concern the kinds of choices that should be made during the implementation of electronic information systems in varied user settings. That is, what constitutes the behavior of individuals and organizations that policies ought to encourage so that full and equitable benefits from technological innovation can be attained? There are at least two perspectives from which the question should be addressed. One takes as its focal point proximate effects in the user context, inquiring about the influence of computerized systems on the quality of working life, types of task-related transactions, and the nature of information as a resource. The second perspective looks to consequences, inquiring what factors are likely to promote positive outcomes--full utilization, increased productivity, decreased costs,

and other objectives at which the implementation of information technology is typically aimed.

Background. Recent literature yields a number of objectives for the introduction of electronic information systems, reflecting primarily an intersection of economic needs and technological opportunities. Among the economic factors behind the drive to automate office operations, personnel costs play a prominent role. Whether an organization is associated with a product or a service, "the office" is associated with information and communications; in particular, "office work" consists of "information handling activities" such as reading and filing documents, performing computations, preparing reports, responding to requests, making and disseminating decisions, and the like (Ellis and Nutt, 1980). In traditional contexts these activities are highly labor intensive and therefore relatively costly--the U.S. spends anywhere from \$376 to \$600 billion a year on salaries of office-based people (Forest, 1979). But while employee costs have continued to increase, office productivity has not: rather, productivity improvements have lagged far behind industrial and manufacturing growth (Keating, 1980; Bennis, 1980). These problems are exacerbated by steady increases in amount of paper work required and the growing scarcity of paper, circumstances that increase labor time and work cost (Young, 1980).

Concurrently a variety of automated information systems have become readily available with market entry costs decreasing, so office computers were naturally seen as the solution. The vice-president of international marketing requirements for IBM, for instance, announced that "increased productivity of both boss and secretary will be the focus of the office of the future" (Marketing News, 1979). Initially computer technology was regarded as a means for achieving savings at the secretarial/clerical level. Thus a 1974 article titled "We Need No Secretaries" (Shiff) argued that such systems could eliminate transcription, typing and filing office work; more modest proposals suggested that office technology could increase secretarial productivity by 25 to 33 percent (Law and Pereira, 1976). The newest wave of automation is intended to replace or enhance the work of highly skilled personnel as well. A survey made by Booz-Allen and Hamilton, in which almost 300 managers and professionals in 15 major U.S. corporations took part, concluded that from 15 to 30 percent of highly skilled office time is spent in information-handling tasks that could be computerized (Business Week, 1980). A Dun's Review article suggests that such systems will reduce the need for middle managers substantially (Gottheimer, 1979).

While redress of serious productivity and cost problems represents the most visible objectives for the implementation of electronic information technology, more generic social goals are also involved. One such goal is the advancement of national

capability for information organization and processing. The well-documented increases in "paper work" are often interpreted as reflective of a transition into the postindustrial age of information (Mankin, 1978; Strassman, 1980). From this viewpoint increasing the productivity of the office "becomes a major social challenge" as industrialized societies become service- and knowledge-based economies" (Driscoll, 1979). From the same standpoint, information becomes a "critical resource" whose effective management is an important component of "long-term U.S. performance" (Thoryn, 1980). Application of advanced technology to information-based work is seen in this light as linked to national progress and social benefits (Keating, 1980).

A second major social concern arises, however, precisely in response to the redesign of the office and the transformed nature of work necessitated by such technological innovation. As one source put it, technological advance "will change the office as a place into the office as a system" (Sadler, 1980). While there is no disagreement about whether electronic information systems will change user contexts and tasks, there is considerable dispute over just what sorts of changes to expect. It is sometimes suggested that introduction of office computers will increase users' skill repertoires and release time from repetitive and monotonous tasks for more autonomous and creative pursuits (e.g., Connell, 1979). Equally often it is argued that such procedures only deskill and fractionate jobs, replacing some workers and increasing the alienation of those who remain. Lower-level employees believe that new technology invariably routinizes work, creates more formalized structures, and leads to more authoritarian management styles (cf. National Association of Secretaries, 1980). Higher level personnel are concerned that organizational changes may decrease their social power while technological changes result in the obsolescence of their skills (Kling, 1980). Thus, the Booz-Allen and Hamilton study (V. above) found administrative, managerial and professional level workers the most resistant of all to the new information technology.

Current Developments. Reviewing the background for the issues raised above generates a number of questions that are wholly or partly susceptible to empirical study and policy intervention. It is therefore instructive to examine reports of the experiences and outcomes of organizational efforts to implement electronic information systems, seeing how current developments compare with projections. It should be noted, however, that most reports on outcomes are not research based but rather reflect selective views of particular organizations, management consultants or systems vendors. Little systematic research has been conducted across user contexts related to the impact of computerized office systems.

A number of accounts present successful experiences. For example, an Administrative Management article (Hansen, 1977) reports surveying several companies that had installed word processing systems; all indicated "productivity gains and cost effectiveness" with the system (cf. also Lewis, 1979 and Modern Office Procedures, 1980). Another study (Anderson, 1978) finds that computer-based message systems improve productivity by saving time, by increasing the volume of work performed, and by more efficient problemsolving. Specific positive accounts range from a pharmaceutical firm (Clutterbuck, 1978) whose office system had saved time at both the managerial and secretarial levels to a life insurance firm (McCormick, 1980) whose introduction of mini-computers and distributed processing had cut proposal preparation time from days to half an hour.

For all such positive accounts, however, there are even more negative experiences on record. For example, a March 1980 Business Week article reports "Many companies are having difficulties making word processing equipment work as planned"; expected productivity gains are believed to require more efforts at organizing the introduction of those systems and especially at overcoming secretarial and managerial resistance. Similarly, a Management Focus article (Krasan, 1980) notes that the "magical machines" work as well as vendors say they do, but that most organizations nevertheless have not seen productivity improve "mainly because people in charge have not been laying the groundwork for office automation" (cf. McIntosh, 1980). Consequently, many of these machines are "sitting unused in some businesses" (Windler, 1979) while "productivity is virtually static and the proportion of white-collar workers is following Parkinson's laws" (Lester, 1978). Meanwhile, attempts to network computer systems run afoul of incompatible communication protocols employed by different equipment producers; by now these "Towers of Babel" have seemingly "gotten out of hand," according to the International Resource Development, Inc. report (1981). Not surprisingly, at a meeting focussed on office systems and information technology, the Administrative Management Society concluded that technological change in this area should slow down "with more emphasis on equipment evaluation based on human resource considerations" (Dickey, 1979).

While inferences drawn from such an unsystematic information base are necessarily tentative, it is fairly clear that although the expected proliferation of electronic information systems is well underway, anticipated benefits have not been realized. Office information technology seems to exemplify Green's more general thesis that technology assessment, "especially in the early stage, likely will show an overweighting of benefits and an underweighting of risks" (1973). In this instance, the risks that went unnoticed were contextual--carrying out major changes in the technology of work successfully requires a number of concomitant changes in the behavior of individuals and organizations. Keen's (1981) recent review of the social impacts of

computing is replete with cases that were at once technical successes and organizational failures. In sum, recognition of a technological opportunity was probably the dominant factor in adoption of computerized office information systems, with attention centered on potential productivity gains or cost savings rather than on implementation processes and user contexts.

Research Contributions. A 1973 NSF report on science, technology and innovation concluded that the benefits of technology confluence should not be left to chance but should be promoted through careful research. Subsequent research into implementation of innovative technology has generated a substantial body of findings applicable to issues surrounding the introduction of electronic information systems in office settings--results potentially useful for guiding future policy-relevant studies. The major conclusion from current research is that successful technology transfer is most strongly affected by the operation of a strictly situational set of characteristics that constrain the implementation of an innovation in a user context (Berman and McLaughlin, 1974, 1975, 1976, 1978; Pressman and Wildavsky, 1973; Glaser and Ross, 1971; Spak and Shelly, 1978; Guba and Bickell, 1974; Jolly, Creighton and George, 1978; Yin et al., 1976; Yin, 1978). This broad-based result is associated with a number of specific and related conclusions. First, efforts to understand how outcomes are determined must focus on group dynamics and other organizational processes impacting on the adopting unit (Tornatzky et al., 1980). Office information systems, then, require investigation at the level of the office work unit, where work units are conceived as groups of persons representing at least two different status levels and whose activities are organized by output or by workflow technology (Dewar and Hage, 1978). Second, this microimplementation perspective underscores the finding that the process requires a great deal of "people-based support" (Fullan and Pomfret, 1977). During the installation of an innovation in any user context, most of the discretionary choices are made "at the bottom" (Elmore, 1979), yet the collective effect of such choices has a great deal to do with the nature and outcomes of what is implemented. Careful attention must be given to the incentives and counterincentives for change. A third, and closely associated, conclusion is that user participation in planning and decisionmaking processes during implementation will be a significant predictor of positive outcomes (Berman and McLaughlin, 1974, 1975). Finally, the search for antecedents of positive and negative outcomes should not be confined to early post-adoption steps in the implementation process. Rather, recent research supports the view that all along the continuum from initiation to full incorporation the innovative system is being changed by the user context even while that context is itself changing to adapt to the system. Such changes may range from minor modifications to major reinventions in the service of original objectives; or they may, on the other hand,

constitute significant deviations from desired goals. Moreover it should be emphasized that alternative strategies during the adaptive implementation process appear to affect not only early outcomes but long term costs and benefits as well (Danziger and Dutton, 1977; Yin et al., 1976; Eveland, 1979).

Besides variables representative of the office work unit, variables representing the larger organizational milieu of which it is a part are likely to play a role in the successful or unsuccessful implementation of electronic information systems. Current research supports the thesis that dimensions of organizational structure significantly influence the technology-performance relationship (Davis and Taylor, 1979; Katz and Kahn, 1978). The dimensions which appear to be of greatest interest for understanding that relationship are: formalization, or the degree of definition of rules, procedures and roles (Miller, 1977); centralization, or the extent to which decisionmaking power is concentrated (cf. Hage and Aiken, 1967); and specialization, or the division of labor as defined by highly specific functions and tasks (Dalton et al., 1980). While these organizational characteristics have a lengthy research history, it is only relatively recently that their effects have been conceived separately from those of more situational work unit characteristics in relation to implementation processes.

Last, characteristics of the new information technology per se cannot be left out of account. Current research makes it evident that, in contrast to early R&D assumptions, the intrinsic merits of an innovation do not assure its widespread diffusion and utilization (Berman and McLaughlin, 1974; Yin et al., 1976). Rather, it is the interaction of those features with the user setting that need attention in the technology transfer process. From the implementation standpoint, characteristics of office computer systems are of interest insofar as they influence the interactions between persons and information, tasks, and other persons who share the workflow technology. Unfortunately very little research has been conducted at that level; advanced information research tends to be basic rather than applied and human factors research, while applied, tends to isolate system features and user responses from the ongoing work context.

Future Research. The discussion of existing research foundations together with the policy issues and their background generates a variety of topics for future research. In terms of the proximal/distal distinction initially suggested, the immediate effects question concerns the impact in work units of efforts to implement electronic information technology. Perhaps the most frequently raised point at first regarding office computers was the potential influence of such systems on job satisfaction and alienation; more recently their association with job-related stress has been emphasized (e.g., Computerworld, 1981). But these topics cannot readily be

approached lacking more fundamental knowledge about the ways in which computer systems provide users in office settings with increased information handling capabilities, or just what they do in the way of task replacement and task enhancement. That is, just how is work transformed? And, especially in respect to nonmechanical "paperwork" (e.g., doing research, studying relevant information, understanding problems, making recommendations, preparing reports), what is the nature of computerized assistance and how can it be expected to interact with or contribute to the carrying out of open-ended and nondeterminate tasks? A second sort of proximal research area has to do with effects of computerized office systems on interaction, negotiation, decisionmaking--how do they influence contents, processes and results? More specifically, in what ways (if any) does the availability of rapidly retrievable stored information, online heuristic and other procedures, and immediate interactive capability using electronic media affect outputs of individual, dyadic, or polyadic transactions? Finally, it would seem important to investigate the nature of information as a national resource and its role in organizations--here even the question requires more precise specification theoretically and empirically. At minimum the conception of information resource management needs to be pursued by social research in public and private sector settings.

In the more distal domain of outcome research, an initial topic of considerable interest is the extent to which findings from previous investigations of innovative technology implementation generalize to the case of electronic information systems. Most previous research has been conducted within the public sector, so that very little is known about technology transfer to the private sector and especially from a user-oriented perspective. Further, the bulk of previous research is drawn from service agencies while implementation of office information systems more broadly affects both product and service organizations. Next, in order to ask what factors influence the outcomes of attempts to introduce electronic systems for information-based office activities, a topic that immediately suggests itself for research is the development of measures of professional or managerial productivity, effectiveness, or work quality. For all but the most repetitive and routine activities, it is difficult to evaluate office work (whether in traditional or computerized settings) and assign systematically to the outcomes a value in terms either of costs and savings or of individual/social improvements and decrements. A third topic concerns the kinds of education and training (or retraining) needed so that work force skills would match the demands of the office of the future, and when and how to commence such a program. A last topic of inquiry might be the federal role in relation to advancing office information technology. A number of recent studies have challenged

the viability of either federal incentives or regulatory policies as instruments of change (e.g., Berman and McLaughlin, 1974; Bardach, 1977; Elmore, 1979; Fullan and Pomfret, 1977). On the other hand, if the major conditions leading to implementation and full utilization tend primarily to reflect internal and situational organizational characteristics, it is appropriate to deemphasize external initiatives in technological innovation; policy direction instead might be provided in the form of how-to's, or operational procedures and recommendations based on research and tied closely to organizational outcomes. Such research is justified because of the federal government's commitment to promote the transfer of technological innovation across various sectors (Tornatzky et al., 1980) and because electronic information systems comprise a timely and far-reaching instance of such transfer.

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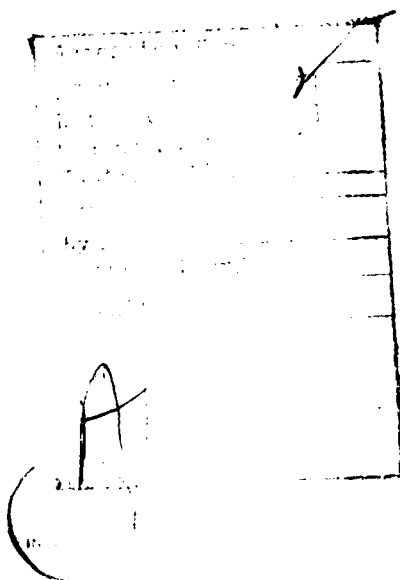
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