Computing and Public Organizations

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Abstract

This survey of empirical research on computing in government updates a review that appeared ten years earlier in *Public Administration Review*. It focuses primarily on research related to the management of computing and on differences between public and private sector management of computing because the bulk of the new research and findings are here. The impacts of computing on employment, structure, worklife, decision making, organizational politics and constitutional issues are treated briefly because there is little new research or new findings. The paper concludes that while the use of computers in government at all levels of the federal system has increased greatly over the last decade, research on computing in government has declined precipitously.

Computing and Public Organizations

INTRODUCTION

The use of computers and information systems has both deepened and widened in organizations over the past decade. The availability of ever cheaper and more powerful personal computers has put increasing computing power into the hands of greater numbers of people throughout organizations. The nature of computer use has also changed as computers have infiltrated the home, largely as an extension of computing in the workplace, and portable computers have become an indispensable traveling companion for many workers. Changes in the nature of computer use continue to accelerate as users are linked by networks within and between organizations, and the Internet brings people from around the world together on a global network of networks.

Computer use in the public sector is heavy and growing. In a Syracuse University study of computer use in state governments, Caudle et al. (1989) estimated that states were spending more than three percent of their executive branch operating budgets on information resource management (IRM). This comes to a total of $19.9 billion for all 50 states. Fletcher and Foy (1994) project that this total would have reached $52.6 billion by 1993. The Syracuse group later looked at computer use in county governments. Fletcher et al. (1992) estimated that county governments in the U.S. were spending $23.38 billion on IRM, or 17.06% of their annual operating budgets. Kraemer and Norris (1994) indicate

that city governments were spending three percent of their operating budgets on computing in 1993. Finally, the General Services Administration places spending by federal

executive agencies at $25 billion in 1993, or two and a half times more than in 1983 (GSA, 1993). The Government Accounting Office estimates federal obligations at $26.5 billion for 1996, but quickly admits that this number may grossly underestimate the real number because (1) agencies whose IT-related spending was under $2 million prior to fiscal year 1996, or under $50 million for fiscal year 1996 and beyond, as well as legislative and judicial branches of the federal government, are not required to report obligation data, and (2) computers that are embedded in weapons systems are not included in reporting categories (GAO, 1995).

The rapid evolution of computing and communications technology offers unprecedented opportunities for the public sector, but also presents vexing challenges for the management of computing in public organizations. This article was originally intended to be an update of a review by Kraemer and King (1986) on what was known and not known about computing in public organizations. The plan was to follow the structure of that paper and update the topics based on research from the past ten years. However, we found that the literature has not advanced much in many of those areas over the past decade. Instead, we found that researchers have been investigating new topics in the management of computing, including differences between public and private sector management of computing.

The article, therefore, focuses on the management of computing in public organizations, exploring the other issues more briefly. It looks at issues related to the effective management of computing in organizations, the impacts of computing on organizations and the diffusion of computing innovations within

and among organizations. It also addresses relationships between computing and organizational structure, employment, work life, decision making, organizational politics and legislative processes. Finally, it reviews the present state of research in the field of computing and public administration and suggests key issues for future research.

MANAGEMENT OF COMPUTING

Two key issues arise in regard to the management of computing in public organizations. The first is how computing technology diffuses between and within organizations. Management of computing is not just about effectively managing existing technology. Even more important, perhaps, is finding new technologies to solve old and new problems. Computer technology changes at a feverish pace, with product cycles measured in months. Managers, therefore, continually search for, acquire, and assimilate new technologies to effect the functioning of their organizations. The second issue is how information systems can be better managed to achieve the goals of public organizations. The two issues are intertwined. Technology diffusion will take place whether managers plan for it or not, through all sorts of informal mechanisms. Conversely, management decisions will greatly influence the path of technology diffusion within organizations. Under the best of circumstances, organizations will manage the process of diffusion as part of an overall strategy for using computing technologies to achieve the organization's goals.

Diffusion of innovation

Technological innovations, such as computers, can only be valuable when they are actually used by individuals and organizations. This is an obvious statement, but it leads to several questions with not so obvious answers. For instance, what forces motivate individuals and organizations to consider and adopt new technologies? Is the diffusion of innovation driven by technology push or demand pull? Is demand for technology greater among end users or MIS managers? How do general mangers help or hinder the process of technology diffusion in an organization?

Bugler and Bretschneider (1993) look at how interest in new information technology (IT) develops and where the technology acquisition process is likely to be initiated in public organizations. They found that program managers are more interested than MIS managers in new technologies because they seek to gain greater control over computing resources. They also found that organizations which share information with greater numbers of external contacts have greater interest in new information technologies. Finally, they found that interest in IT is correlated to users' perceptions that they face high barriers to information sharing. These findings suggest that public organization managers seek new information technologies to overcome barriers to outside communications and to improve their reporting ability to outside agencies. They also suggest that organizations with higher levels of outside contacts are more likely to become aware of new technologies that might be applied to those problems. Finally, and most surprisingly, they suggest that innovation diffusion is driven largely by end users trying to solve specific problems, rather than by technical elites with greater knowledge of the new technologies. This is surprising, since studies of the private

sector show that MIS managers usually rate the value of IT more highly than other executives (Kraemer et al., 1994).

Caudle (1990) found that strategies for developing information technologies in the federal government tend to come from middle management, rather than top managers who are often political appointees. These middle managers are comparable to Bugler and Bretschneider's end users. Unlike top managers or MIS managers, they are the ones who understand the problems and challenges faced by the organization. They also have long-term relationships with people in external organizations, developed over years of interaction. The combination of knowledge of organizational needs and sources of external information appears to put these managers in the best position to pull technology into the organization.

This connection between outside interactions and awareness of new technologies is important, because it helps explain how end users become aware of technologies that might help them solve problems. Moreover, it shows that the typical supply push approach is inadequate to drive technology diffusion by itself. Suppliers of new technologies often promote those technologies through channels that only reach their fellow technologists, such as MIS managers, who are often unfamiliar with the problems and needs of end users or how to present the capabilities of products to those users. They tend to describe their products in terms of technical features or generic functions such as GIS, rather than specific functions such as GIS for 911, for land use planning, for facility location or for urban analysis. An MIS manager who understands the needs of end users should be able to make the translation necessary to relate technological capabilities to

organizational needs, but these findings suggest that this is often not the case. Rather, the end users appear to be finding out about useful technologies from users in external organizations with similar needs, i.e., the organizations with whom they interact closely.

Looking at innovation diffusion through another perspective, Northrop et al. (1994) investigate three factors commonly thought to affect computer use in organizations: training, friendliness of software, and users' background with computers. Using data from over 3,000 public employees in 46 U.S. cities, they found that training is an important and underutilized asset. Training can help users overcome the limitations of software that makes it difficult to use. Training can also overcome limitations in employee experience with computing. In fact, they found that users' computer literacy and prior training is more important than the number of years employees have used computers. They conclude that user training should be emphasized in getting employees to use computers in their jobs, especially when difficult-to-use software acts as a barrier to adoption. Conversely, user friendly software can compensate for lack of user training and experience.

The foregoing findings point to both external and internal factors affecting the diffusion of innovation in organizations. Stevens et al. (1990) study the importance of external and internal factors on the transfer of IT in state governments. They argue that the singular focus on either set of factors is a "straw man" argument that detracts attention from developing an integrated model which takes both external and internal factors into account. They find that external factors, particularly size and economic activity of organizations, are associated with technology transfer patterns. However, they agree with Kraemer et al. (1989)

that internal factors under the control of managers also affect the application of IT in state governments, and that application of IT within organizations can be shaped significantly by managerial initiatives.

Effective management of computing systems

There has been an ongoing debate about the productivity gains achieved from investments in IT. Several studies in the 1980s (Baily, 1986; Roach 1987; Loveman, 1988) argued that there was little evidence of increased productivity in the American economy in general, and the service sector in particular, from the billions of dollars that had been spent on IT. The alleged "productivity paradox" has been challenged by more recent studies by Brynjolfsson and Hitt (1993), Lichtenberg (1993), and Kraemer and Dedrick (1994), which show strong correlations between IT investment and productivity gains at the corporate and national level.

The debate over the value of IT investment in the aggregate is mostly the concern of academics, but when the focus shifts to individual organizations, it becomes a more urgent matter to managers. It is difficult enough to try to measure the return on IT investment in the private sector, where output can be valued in revenue dollars. It is more difficult to calculate the return in public organizations, which provide public services, not services for sale. Yet, maximizing the productivity of workers through the application of IT is equally important to public organizations, which must meet increasing demands for services on ever tighter budgets. So while it is not easy to measure the value of IT in public organizations, those organizations are extremely concerned with improving the effectiveness of their management information systems (MIS).

Probably the most extensive research on computing in public organizations in recent years has dealt with how to manage information systems to achieve organizational goals. Studies at different levels of government have looked at issues involved in using "high tech to better effect," to use Caudle's (1987) phrase.

Applying IT to achieve organizational goals

A number of researchers have been critical of the use of computing technologies in public agencies, arguing that those organizations had a long way to go to effectively apply those technologies to better effect. One of the most common arguments has been that MIS research, training and practice has been too centered on technology, rather than on the application of information systems to improve organizational functioning. This argument echoes recent studies (Davenport, 1993; Hammer and Champy, 1993; Drucker, 1995) which claim that application of IT in itself does not result in productivity gains. Instead, it is argued that IT makes possible the rethinking or reengineering of organizational processes which actually result in productivity gains. If that is so, then focusing on the technology alone will not achieve the desired results from investments in IT.

Caudle (1987) put much of the blame on training programs and graduate school curricula that concentrate too much on technology management and not enough on information resources management (IRM). The IRM movement argues that organizations should focus on managing information resources rather than technology *per se.* It is very popular with federal and state government agencies although at least one GAO report (1992) and one academic article (King and Kraemer, 1988) have challenged its effectiveness and its conceptual soundness. Caudle argued that managers in public organizations were increasingly concerned with managing IT to improve organizational functions, but that management schools focused mostly on technical skills. She made the point that program staff are the innovators in the adoption of new technologies, driven by organizational needs to use information more effectively (an argument reinforced by

Bretschneider, as discussed above). However, she argued that business and public management curriculums were "in a very sorry state" in terms of managing the application and impact of IT in organizations. This sorry state exists despite the National Association of Schools of Public Affairs and Administration's (NASPAA) adoption of curriculum guidelines for computers in public management (Kraemer and Northrop, 1989). Apparently, few schools adopted the new guidelines and NASPAA did not enforce them.

Chisholm (1988) likewise states that the typical approach to technology management has been to choose the technology and treat the assimilation of the technology by workers as an afterthought. He argues that active employee involvement is a more crucial part of the work process as advanced information technology is employed in the organization; therefore, achieving the potential of IT requires taking both human and technical factors into account when designing work processes. Martin and Overman (1988) likewise argue that the failure of IT to transform organizations is due to the failure of managers to integrate information needs and cognitive expectations with the management activities of organizations. They reflect an earlier critique by Wildavsky (1983) in blaming management information systems for generating raw data rather than useful information that can be incorporated into the decision making process of organizations.

The common theme in the papers cited above is that the value of IT to organizations depends mostly on how the IS function is integrated into the broader management processes of planning, decision making, program implementation and evaluation. IT tends to be effective when it is used as a tool for changing and

improving the way the public organization carries out its various functions. If IT is just used to make poorly designed existing procedures more technically efficient, the benefits to the organization are minimal. On the other hand, implementing new information systems to solve problems is fraught with risk, as was discussed in the previous section.

Structure of the IS function: Centralization versus decentralization

There has been an ongoing debate for over a decade regarding centralization and decentralization of computing activities. Advocates of decentralization say that decentralization brings the computer package under the direct control of end users, who gain greater mastery of the technology and can shape it to meet departmental needs. It also weakens the role of central MIS managers who are presumed to be more interested in technical matters than in understanding end user needs. This argument fits nicely with the points made above about the role of end users in driving technology adoption and the importance of tailoring information systems to the operational objectives of the organization. The introduction of personal computers and client-server computing based on standard software packages has bolstered the argument for decentralized computing. While the size and cost of mainframe computers argued for centralization of the computing function, PC technologies make it feasible to break up that function into smaller departmental units.

Centralization, on the other hand, is believed to increase economies of scale in procurement, enhance interagency coordination in the use of data, and provide IS managers with the ability to guide computing toward organization-wide goals (Danziger et al., 1993). The case for centralization has been based on

notions of efficiency in the IS function itself, rather than enhancing the end users' access to, and control over, information technology. Studies of public organizations (e.g., Kraemer et al., 1989) note a trend toward decentralization of computing functions since the mid-1970s. However, despite the trend toward decentralization, most organizations continued to have a central computing unit, and in recent years, the pendulum seems to be swinging back toward centralization, as a way of getting some control over the proliferation of often incompatible end user technologies in various departments.

Whether computing is centralized or broken into smaller departmental units is a critical issue. Some argue that centralization of managerial control rather than facilities and services is the key factor. However, it is frequently the case that control follows the location of facilities and services. That is, the tendency is for managerial control to be centralized when facilities and services are centralized, and decentralized when facilities and services are decentralized. Of course, there also are instances involving a mix of centralization and decentralization, e.g., central control but decentralized facilities and services.

It would seem that the decision to centralize or decentralize computing would have significant consequences for the quality of services provided to users. However, Danziger et al. (1993) surveyed 1846 end users in 46 U.S. cities and came to the startling conclusion that the user ratings on the quality of computing services are virtually identical for those who received services from central units versus departmental service units. They suggest that the real concern of advocates for centralized and decentralized computing is one of political power and control within the organization, rather than concern over quality of computing services. If

information is power, then centralized computing centralizes power at higher levels in the organization, while decentralized computing devolves more power to subunits within the organization.

If organizational structure is not a critical determinant of the quality of computing services, then what factors are important? Danziger et al. (1993) point to three factors: technology, people and the state of computing development.

Technology

End user satisfaction with computer services is associated with fewer technical and service problems and promotion of useful applications. To improve the technical performance of the computing function, managers should provide incentives to computing units "on the basis of explicit, measurable performance criteria such as the timeliness of response to users' requests for computing products, the reduction of down time, and the minimization of disruptions due to technical changes in systems and procedures" (Danziger et al., 1993). These criteria can be applied to both internal and external providers of services.

People

The relationship between end users and providers of computing services are critical to the end users' perceptions of the quality of services. Computer specialists who are responsive to users' needs lead to high ratings of service quality. Managers should provide incentives to services providers to respond to users' needs, and should try to ensure that technical personnel comprehend the tasks of end users and use the terminology of users in explaining technical issues.

Most of the recent literature on diffusion of innovation and management of computing argues that it is end users who drive the adoption and useful

application of new technologies, and therefore, control of the technology should be kept close to end users. This argument has been behind the trend to decentralize the computing function, especially as the availability of personal computers and client-server computing has provided the technology to make decentralization possible. However, recent empirical studies have shown that there are problems associated with letting decentralized agency computing grow unfettered. As Danziger et al. (1993) and other researchers have shown, decentralized and centralized computing can be equally effective.

State of computing development

It is increasingly clear that the key determinants of computing quality and value are more likely to be the ability to tailor information technology to the needs and characteristics of the organization. Simple arguments about the superiority of decentralized or centralized computing miss the complexity of the problems involved in the management of computing. This point is brought home in a series of longitudinal studies in cities by Kraemer et al. (1989) and in federal agencies by Laudon and Westin (1986). The studies by Kraemer and colleagues show that computing can be characterized by various "states of development" and that these states determine the effectiveness of computing within the organization. Three pure states are identified—skill, service, control and a fourth "mixed" state.

In the skill state, IS management controls computerization and applies computing resources to technical interests. In the service state, departmental management controls computing, and the operational interests of these departments are served. In the control state, senior management controls computerization, and its broad managerial interests are served. A mixed state

exists in the absence of any of the three pure states. That is, the mixed state encompasses any set of conditions where the level of control and the level of interests served do not directly correspond. There is no consistent link between the control over means and the particular ends sought in the mixed state.

The practical significance of this theory is that the state of computing management in an organization is independent of particular information technologies or their states of development. It focuses on management action, whether direct or indirect, as the controllable driver of computing development and change. And it permits the identification of the current state of computing in an organization, as well as the prediction of the future trajectory of computing, given that state. Moreover, it shows how the trajectory of computing is governed by management action.

Differences in public and private sector computing

Management of computing presents many common problems and issues for all types of organizations. However, there are clearly differences among the computing needs of different organizations and the best ways to address those needs. These differences may be due to differences in organizational size or function. Of particular interest in the context of this paper are differences between management of computing in public and private organizations. The majority of the literature on MIS is based on studies of private sector organizations. Less attention has been given to developing formal models of public sector MIS or to specific problems faced by public sector MIS personnel. Bozeman and Bretschneider (1986) contrast public and private organizations in terms of their external environments and their organizational structures and practices. They find,

for instance, that while private organizations are evaluated in terms of economic efficiency and profitability, public organizations are judged for their political efficiency and achieving their policy mission (e.g., delivering the mail, making welfare payments).

Based on these differences, the authors present a number of guidelines for public sector management information systems (PMIS). For instance, managers should realize that public sector mistakes can have devastating consequences, such as retirees or welfare recipients not receiving checks they depend on for survival, or prison inmates being mistakenly paroled. Given the urgency associated with such public sector functions, PMIS managers are warned to carry out a protracted period of testing before implementing new systems. The costly delays in opening Denver's new airport due to the failure of a computerized baggage system illustrate the expense and embarrassment that can result from a computer system failure in the public sector. Private organizations face similar concerns, but competitive pressures can make it more costly not to move quickly. Also, with a few exceptions, mistakes by private sector organizations are less likely to have such dramatic ramifications.

Bretschneider (1990) and Bretschneider and Wittmer (1993) look further into the differences between public and private organizations and the effects of these differences on information systems management. Based on surveys of public and private data processing organizations, he concludes that public organizations face greater interdependence and accountability, and hence public MIS departments face more red tape than their private sector counterparts. While private sector MIS managers can make decisions based on purely economic

criteria, public sector managers must take into account procedural issues related to the layers of oversight under which public organizations operate. When making decisions about procurement, hiring, dismissing, or when developing new systems, the process as well as the decision must stand up to the scrutiny of the agency's overseers. Because of the nature of the environment in which they operate, public organizations often adopt different MIS practices from those of the private sector. For instance, public MIS managers place more value on "state of the art" technology as a criterion for procurement, possibly due in part to the lengthy process often encountered in acquiring new hardware and software. Public managers might be trying to ensure that new systems are not obsolete by the time they are installed.

While research comparing computing in the public and private sectors is scarce, it is clear that the two sectors operate in different environments and face different managerial demands. The following section looks in more detail at recent research on the management of computing in the public sector.

IMPACTS OF COMPUTING

The spread of computing technology has had a major impact on the way work is done, decisions are made, organizations are structured and how people interact. Some of the impacts are quite obvious: documents are typed on computers rather than typewriters, spreadsheets are used for financial planning, records are kept in electronic databases, and memos are distributed via electronic mail. Other changes are less obvious, but possibly more significant in their impacts. Access to information can change the location and nature of decision

making, entire job classifications disappear while new ones are created, layers of management are eliminated, organizational politics take on new dimensions, and jobs can become more or less satisfying to workers. Many studies over the years have looked at the impacts of computing on people and organizations. Recent studies have focused on the effects of individual technologies such as client-server computing, decision support systems, electronic mail and groupware. A few efforts have been made to develop a broader theoretical framework for understanding the effects of computing.

Computing and organizational structure

Most of the debate about computing and organizational structure has focused on whether computing results in the centralizing or decentralizing of decision making in the organization. Centralization refers to the distance between where a problem emerges and where in the organization's hierarchy decisions about that problem are made. A centralized organization is one in which most decisions are made at the top by a single individual or a small group (Kraemer and King, 1986).

In the days of centralized, mainframe computing functions, it was often postulated that computing systems would tend to centralize the decision making process. It was expected that information needed for decision making would be consolidated under the control of top management. It was also thought that computers would execute routine decisions and pass the remainder to top management. The advent of minicomputers and PCs tended to decentralize access to information and led to predictions that decision making would likewise be decentralized as lower level managers took advantage of the opportunities offered

by that access. The empirical research has indicated that computing *per se* is neither a centralizing or decentralizing influence. The context in which computing is used is a much stronger influence on whether organizations centralize or decentralize than is the technology, which can support either type of arrangement. In general, computing tends to reinforce existing tendencies and is not likely to affect organizational structure in significant ways by itself (King and George, 1991; Kraemer, et al. 1981).

This does not mean that computing plays no role in organizational structure, however. Computing can be a powerful tool in facilitating organizational changes, as the literature on reengineering of organizations emphasizes. An organization that wishes to decentralize can implement information systems which provide necessary information to lower level managers and permit oversight by top management over those managers. Computers have clearly facilitated the trend toward downsizing of middle management. A study by Pinsonneault and Kraemer (forthcoming) shows that whether computing results in increases or decreases in middle managers depends on the congruence between centralization of overall control in the organization and centralization of control over computing decisions. In organizations where both are centralized, computing is likely to be used by senior managers to substitute technology for middle management functions such as information processing and communication. In organizations where both are decentralized, computing is likely to be used by middle managers to enhance their value to senior management and to increase, or at least retain, their numbers. However, their study also shows that while the growth of middle management is part of normal bureaucratic

processes, a decline in middle management usually requires a dramatic external stimulus such as a large loss of revenues, markets or monopoly power. To summarize, computers and information systems have not created a bias toward any particular organizational structure, but they can be an important tool in implementing organizational restructuring, whether centralized, decentralized, hierarchical or networked.

Computing and employment

There has long been concern over the impacts of computers on employment. The ability of computers to perform routine tasks such as bookkeeping more rapidly than humans led to concern that people would be replaced by computers. The response to this argument was that even if computers led to the elimination of some workers, other jobs would be created, particularly for computer professionals, and that growth in output would increase overall employment. This argument makes sense for the private sector, which can expand its overall output as productivity is increased, but is more problematic in the public sector. A more efficient Department of Motor Vehicles will not increase the demand for driver's licenses. Theoretically, a more efficient public sector should lower the cost of government and free up capital for investment in the private sector, thus creating new jobs, but such effects are extremely difficult to identify.

The net effect of computers on employment is still very much a matter of debate. Employment in particular jobs, such as secretaries, telephone operators and bank tellers has definitely decreased with the increased use of office computers, computerized switching systems and automatic teller machines

(National Research Council, 1994). Such clear-cut cases are uncommon, however. The statistical measures used to determine employment conditions are not precise enough to isolate the effects of one factor such as the use of computers (Attewell, 1991; Kraemer and King, 1986; Rule and Gimlin, 1995). After decades of computerization of all sectors of the economy, the United States has generally achieved full employment in periods of economic expansion, while experiencing cyclical unemployment during periods of recession. The ratio of public sector to private sector employment has not changed much either. It is more likely that computers have led to changes in the types of workers needed and in wage rates for different occupations than in total employment.

Computing and work life

Computers change the work experience by altering the work environment and the nature of job skills, and by affecting the quality of social interaction within the organization. One effect of computers on the work environment involves the levels of job stress and work pressure experienced by information workers. While a few studies find that automated systems decrease time pressure (Kraut et al., 1989), most research indicates that computing increases the level of stress and pressure on workers (Danziger and Kraemer, 1986; Attewell, 1987; Perolle, 1987; Kraemer and Danziger, 1990). However, these and other studies have found that computers have had a positive effect on workers' job satisfaction and interest in their work. For some, the ability and access to manipulate information gave them a greater sense of control over their work (Kraemer and Danziger, 1990). Others felt their status was increased among coworkers and clients due to their mastery over a sophisticated technology (Moore, 1987). This

effect is probably less important today as more workers become familiar with the use of computers and the technology is seen as less alien or difficult to master.

There has been an ongoing debate over whether the use of computers reduces or expands the skills associated with particular work roles (Kraemer and Danziger, 1990). Most empirical research has concluded that computing has generally expanded the number of different tasks that are expected of workers and the array of skills needed to perform those tasks. In a study of middle managers, more than 70% reported that office automation had increased the variety of skills they needed in their jobs (Millman and Hartwick, 1987). The fear that computers would lead to the "deskilling" of jobs is generally unfounded, with the exception of certain types of clerical work (Perolle, 1988; Attewell, 1991).

The impact of computing on social interaction in organizations has increased noticeably with the widespread use of computers made possible by the introduction of personal computers. These impacts now extend to peer-to-peer relations, supervisor-subordinate relations, and to computer expert-end user relations. Peer-to-peer relations have been affected most by information systems that cross departmental boundaries. The interdependence between individuals and work groups has increased as such systems allow and even require sharing of information and coordination of activities (Kling, 1992; Kling and Jewett, 1991). Communications among peers has also increased. In particular, the use of e-mail and PC networks have increased communication among geographically dispersed peers (Snizek, 1987).

Computers have had mixed effects on the quality of social interaction between superiors and subordinates. This interaction seems to have been

adversely affected by the use of computerized monitoring systems (CMS) (Perry and Kraemer, 1992). However, the use of e-mail has had more positive effects. The more impersonal nature of e-mail can lower the barriers to communications caused by different status levels, resulting in more uninhibited communications between supervisor and subordinates (Sproull and Kiesler, 1986). The interaction between end users and computer experts has received less attention, but Danziger and Kraemer (1986) found that end users who interact with more responsive computer experts are more likely to have fewer problems using the technology and report greater job performance benefits and more favorable work environments than end users lacking such interaction. This finding reinforces the importance of the responsiveness of MIS departments to end user needs reported in studies of management of computing.

Computing and decision making

We have already stated that the use of computing systems does not tend to favor either the centralization or decentralization of decision making within organizations. This does not mean, however, that computers have not affected the nature of the decision making process. The contribution of computing to decision making stems from two factors. First is the enhancement of the ability to organize, maintain and retrieve the information needed to make a decision. The second is the modeling power of computers, which allow large amounts of information to be reduced to key indicators that are understandable and usable by decision makers. The ultimate vision of computer-aided decision making is the decision support system (DSS), in which decision makers have access to powerful models

and all the data necessary to run those models under different assumptions (Dutton and Kraemer, 1985; Kraemer and King, 1986).

Earlier research found that the impact of computers on decision making was more impressive at the operational level than at the management and planning levels envisioned by DSS proponents (Danziger, et al., 1982; Dutton and Kraemer, 1985). As might be expected, once a computer model was developed and found useful in dealing with a particular management problem or issue, the issue was pushed down into the operational level and the model followed the delegation of decision authority (Kraemer and King, 1993, 1995; Kraemer 1995). Computers are useful in setting the stage for decisions, by providing needed information on matters such as the availability of funds to make investments, but were not so useful in deciding whether to make a particular investment. Computers also provide a means of monitoring incoming information to determine when decisions need to be made. For example, information on departmental spending can be monitored to know when a department is exceeding its budget.

The value of computers in more complex decision making processes is limited, but still important. Decision support systems do not generally provide the answers to complex questions, but the process of modeling can facilitate decision making by clarifying the issues under consideration, requiring decision makers to specify the assumptions they are making and focusing attention on areas of disagreement that require compromise (Dutton and Kraemer, 1985; Andersen and Dutton, 1995; Kraemer and King, 1995). Complex issues, such as what effect lower tax rates will have on government revenues, can be dealt with in a more

realistic manner. Different models will produce different results, based on the assumptions built into those models. As Kraemer and King (1993, 1995) point out, the use of models can easily be politicized, but if they could not be used as weapons in the political debate, they would not be used at all. And despite its use as a political weapon, Dutton and Kraemer (1985) note that the modeling process at least forces decision makers to state their assumptions explicitly, permitting the debate to be based on quantitative issues, rather than on the basis of ideology and political posturing alone.

In a study of environmental impact assessment and community development block grants, Innes (1988) finds that data gathered by agencies are seldom used directly in decision making, but do have an important indirect influence in shaping the planning process. Requirements for data gathering increase the technical capabilities of agencies, improving the analytical quality of the planning process. Data requirements also increased the opportunities for citizens to use data to participate in the planning and policy making process. Even though the data were often not used directly, the requirement for data gathering influenced the terms of the planning debate by setting norms for discourse and establishing criteria for decisions. The availability of data empowers new participants, allowing them to call attention to issues and more effectively influence the decision making process. In this case, the simple act of gathering, managing and providing access to data helps to democratize the decision making process, an interesting outcome not often considered by champions of decision support systems (Innes, 1988).

To summarize, computer-based information systems can play an important role in planning and decision making by public organizations. At the operational level, computers are useful for setting the stage for decision making and monitoring the organization's activities to alert managers of the need to make a decision. At more sophisticated levels of decision making, the value and role of computer-based models is more indirect. Decision support systems do not generally provide the answers to complex questions, but the process of modeling can facilitate and improve the decision making process. The use of models often becomes politicized, but still helps clarify the terms and framework of debate. And the process of data gathering and organization can democratize the decision making process, by empowering more parties to participate in that process.

Computing and organizational politics

The fundamental question about computing and organizational politics is who gains and who loses from computing. Some have predicted that computing will shift power to technocrats, while others have suggested that computing can strengthen pluralistic features of organizations by providing different interest groups with the tools to respond to their opposition. Others maintain that computing reinforces the existing power elite by providing them with tools to perpetuate their power. Earlier research suggested that the latter is the most likely outcome. Existing elites would use their control over the acquisition and application of computing technologies to maintain their powerful positions (Kraemer and King, 1986).

Innes's (1988) findings about the democratizing effects of data gathering requirements bring those conclusions into question. While the application of

computing within the organization might reinforce existing power arrangements, the availability of data in electronic form can empower new participants in the decision making process of public organizations. Even within the organization, the spread of networked PCs, e-mail and other decentralized technologies creates a decentralizing force on information, providing opportunities for new actors to gain influence. The effects of decentralized technologies on organizational politics is not yet well understood, and is a subject deserving of continued research as those technologies become almost universally deployed within organizations (Norris and Kraemer, forthcoming).

CONCLUSIONS: RESEARCH ISSUES

Weaknesses of current research

The most striking weakness of current research, in comparison to a decade ago, is the sheer paucity of research. We were hard pressed to find many research articles dealing with computing in public organizations in leading journals of public management, information systems, or business administration. We were even more hard pressed to find relevant books, reports, working papers or other documents from research institutes, public administration departments and government agencies.

Based upon the institutional homes of the authors reviewed in this article, there also appears to be fewer researchers and research centers focused on the study of public sector computing and communications. Much of the research is by the same small group of people doing work between 1976 and 1986 on which the earlier review was focused. And, unfortunately, some of the articles cited here are only more recent restatements of that earlier research rather than entirely new

research. The dominant centers of research appear to be at the University of California, Irvine and Syracuse University, with other institutions having one or two researchers.

In general, if one looks broadly at the literature on computing and public organizations, there has been a shift away from serious study of either the impacts of computing or the management of computing and towards the promotion of computing use in all its various forms. This is illustrated by the frequent, glowing articles, especially in recent years, about the Internet, the worldwide web, NII (National Information Infrastructure), or particular computer applications. These new topics take the form of tutorials, tips on "hot" web sites, and descriptive writings. There is very little empirical research on the use, organizational impact or management implications of these newer developments.

In addition, the teaching of computers in public management seems to also have devolved from concern with higher forms of computer and communications literacy (NSPAA, 1986) to a service function concerned primarily with the teaching of general purpose (word processing, spreadsheets, database) and special purpose (personal, budgeting, or other functional uses) computer applications (Waugh, et al., 1995).

Pressing questions requiring research

Many of the issues that concern public managers and academics are technical and are dealt with adequately by computer science, economics and business administration. Illustrations of such issues are the development of standards for interconnectivity and interoperability, network security, pricing of Internet services, and deregulation of telecommunications. The focus of public

administration research should be on issues that derive from what is special about computers and public administration. Although there might be others, at least two issues seem central to public administration: (1) What are the constitutional implications of the growing use of computers and communications? and (2) What are the public management implications?

The constitutional implications have previously been laid out by Westin and Baker (1972), Westin (1985), Laudon (1986), and Kraemer and King (1987). They concern four broad relationships: (1) interactions and relative power among the branches of the federal government in the context of their constitutional duties and the role they play in governmental affairs, (2) interactions and relative power among the national government and other governments in the federal system, (3) interactions and relative power distribution between government and the people, and (4) functions of the political process that result in the election and appointment of officeholders under the structure provided by the Constitution.

Although the previous reviews were generally sanguine about the implications of computing for the constitutional issues, the situation requires continuing monitoring and assessment because the technology and its uses are changing dramatically. There is reason to believe that current developments might be upsetting the delicate balances struck by the Constitution among the branches of government in the separation of powers doctrine, among the levels of government in federalism, between government and the people in the Amendments, and between various factions in the political system in the electoral process.

The public management implications have not been so clearly laid out as the constitutional ones, but the issues are no less portentous—at least for the operations of government. They include issues such as: (1) the government's own use of information technology in the delivery of services to citizens, (2) the provision of easy access to government information for individuals, groups and corporations, and the pricing of such information, (3) the successful implementation of large-scale automation projects, whether entirely new systems or attempts to modernize old systems, (4) the performance impacts in terms of quality and cost of service delivery, and (5) the rate of government investment in the technology, i.e., the benefits of faster diffusion to realize benefits more quickly versus more gradual diffusion to avoid technical cul de sacs and disasters.

The audit reports of the U.S. General Accounting Office on information technology in the federal government, and similar reports by state and local governments, provide ample evidence that these operational and management issues exist throughout the federal system. Moreover, the fact that these reports document the same kinds of management problems with the technology time after time indicates the need for serious research to address the underlying issues. As put in a recent GAO (1995) report:

> Currently, 11 federal agencies have problems with information management or systems development that are serious enough to be listed in the GAO, OMB, and/or GSA programs to identify high risk. The systems under development are key elements of mission-critical improvement initiatives involving such critical areas as air traffic control, veterans claims processing, and income tax processing. Costly

> in themselves, these new systems are intended to support program improvement initiatives that, altogether, involve multibillion dollar investments. All of the initiatives were placed in the high-risk programs because they warrant increased oversight by the Congress to ensure that top management in the agencies takes steps to resolve IT problems.

Unfortunately, we are not sanguine that either the constitutional or the public management issues will be addressed in the near term as there is almost no financial support for such research within the National Science Foundation, within government agencies, in schools of public administration, or in private foundations theoretically concerned with the social implications of information technology (e.g., Benton Foundation, Markle Foundation, Aspen Institute, Ford Foundation). The dismal and enduring political and budgetary climate in Washington, and in most state and local governments, makes it even less likely that there will be government support for such research in the foreseeable future.

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