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**THE IMPACT OF INFORMATION TECHNOLOGY ON CITY GOVERNMENT IN
THE UNITED STATES**

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I. INTRODUCTION

The application of information technology (IT) has played a major role in the transformation of urban governments over the past 30 years and is likely to have even greater effects in coming years. Looking to the future we can speculate on a number of possible scenarios that might develop as information technologies continue to evolve and as innovative applications of IT are created. As with most predictions about the future, these scenarios can only be considered speculation. The real question is "What will the changes be?" From their focus on information technology it seems that many futurists of the city believe this technology holds some important and powerful potential to cause changes. Yet few of the scenarios developed with IT as a central theme explicitly address just what changes information technology brings to the metropolis or how the changes come about.

In this paper we build upon current knowledge about the impact of information technology on the management of city government. The purpose is to construct a picture of the changes occurring in city government that provides us with guidelines for making predictions about the role of IT in the management of city government in the near future.

Our analysis will show that IT does not offer a panacea for coping with many of the difficult issues facing the modern metropolis. Many of these problems are simply too extensive and complicated to be solved by any new technology. Our analysis also will show that IT has not, of its own, caused changes in the organization and management of city government. Nevertheless, the use of new information technologies has led to improvements in the management of city government in four areas:

1. Better planning and control over both internal government operations and physical and economic development in the city through centralized planning, coordination, and evaluation of service programs and development policies;
2. Greater productivity measurement, monitoring and control to ensure that street-level bureaucrats meet qualitative and quantitative standards of performance;
3. Greater innovation at the street-level interface between government and citizens in service delivery;

4. Better information and decision-making techniques to apply to the resolution of complex issues.

However, the technology merely enables such improvements; it does not ensure that they will take place. To exploit these potentials, managers of the modern city must take an active and intelligent role in the strategic use of the technology. They can use the technology either to reinforce the status quo, or to help bring about a new and better order. The direction taken will depend on the insights and skills of the modern managers and on their willingness to lead the introduction of change. Therefore, it is incumbent upon them to realize the interrelation between the emerging opportunities of the technology and the changing context of city government, and to manage both for the benefit of their cities.

This paper takes three steps toward providing government officials with guidance: (1) it examines the evolving context of city government and new challenges faced by city managers; (2) it looks at the role that information technology has played in changing the structure and functions of city government, and the likely role it will play in the future; (3) it examines the political consequences of information technology so that the city's managers can better decide the government's direction in applying the technology to managing the city.

II. EVOLVING CONTEXT AND CHALLENGES FOR CITY GOVERNMENT

For some time, city governments have faced an endemic dilemma—maintaining sufficient centralization of control in city management that enables oversight, efficiency, and accountability; while providing sufficient decentralization to deal adequately with the problems of size and complexity and the demands of neighborhoods and special interest groups. Several reforms have attempted to resolve this dilemma, such as the creation of "little city halls" and neighborhood centers to augment the function of the central city hall. However, none of the experiments to date have produced the desired outcome—an effective balance between centralization and decentralization such that the desired effects of both are realized.

The ebb and flow of reforms that centralize or decentralize arrangements simply reveals the great difficulties faced in achieving "balance" between the two. To understand the challenge facing city governments, it is necessary to focus on the powerful forces at work in the centralization/decentralization issue. Stated briefly, reforms aimed at centralization are designed to enhance executive leadership and internal efficiency; reforms aimed at decentralization are designed to enhance citizen representation and effective delivery of external services. The dilemma in designing a balanced structure of city government derives from the basic expectations for performance put on government in light of the fundamental constraints on how government can be organized.

Two problems in particular create an ongoing tension between centralization and decentralization of city government. First, the resources provided by the citizens in the form of taxes tend to come in large, monolithic sums that are not tied directly to the services the citizens expect to receive. Thus, there is little *a priori* guarantee that monies collected from the public will actually be spent in accordance with their desires. At best there can be serious mismatches between the desires of the citizens for services and the money available to deliver them; at worst, funds can be improperly or illegally used. The typical remedy for this problem has been to centralize the financial activities of urban government in tightly controlled, professional departments, while establishing detailed policies covering how monies will be spent in functional units. Discretion at the subunit level is limited.

The second problem is that knowing the "will" of the citizens and the genuine needs of neighborhoods requires a clear and detailed understanding by those officials who make the case for public action. This encourages the development of important aspects of urban governance (including decision making power, autonomy, and financial support from the general fund) to the citizens and the neighborhood committees who best understand local interests--clearly a decentralizing action since the local citizen groups do not fall within the purview of central management control.

A number of major changes have taken place in the United States in the past decade that have heightened the tension inherent in the dilemma: the aftermath of expanded services provision spawned by federally supported programs; the cutbacks in funding sources for urban governments in many locales; a generally skeptical and critical attitude of citizens toward government; and a tendency to push an increasing number of responsibilities that had drifted to the state and federal levels back down to the local level. The new Republican leadership in the U.S. Congress promises reforms that would devolve the administration of a number of federal programs to state and local governments. Federal funding would be provided in the form of block grants, but local governments will be under greater pressure to finance their own activities as the federal government attempts to cut its own spending to reduce the budget deficit. Local governments will likewise have more autonomy in the management of programs and in the allocation of resources. The impact of these shifts for the city's executive leadership is likely to exacerbate the characteristic problems of city management. In particular, these shifts affect certain key management problems:

1. Generating revenues and controlling expenditures. The shift towards greater local financial responsibility for urban services and the corresponding neighborhood pressures to maintain services is increasing the demand on city hall to generate new revenues, collect current revenues more efficiently, allocate funds to the functional departments

more effectively, maintain tighter control over how the funds are expended, and evaluate departmental performance.

2. Controlling the city government bureaucracy. The independence of the bureaucracy, which has been fostered by professionalism and the functionally-oriented pattern of financial support by higher level governments, is being reinforced by political support from neighborhood constituencies, by the decentralization of administrative units to the neighborhoods, and by the differential ability of some departments to raise and keep new revenues (e.g., those based on user charges). Thus, city management is faced with the need to re-establish its political authority for planning and coordination, and monitoring and control over the more dispersed activities of the functional departments in the city government bureaucracy.
3. Applying information to complex decision problems. The decentralization of urban service delivery and the differentiation of policy implicit within such decentralization has made the problem of determining city-wide and neighborhood policies more complex.

To the extent that information technology has a dramatic impact on the management of the metropolis, it is likely to be in relation to these centralization and decentralization shifts.

III. IMPACTS OF INFORMATION TECHNOLOGY ON CITY GOVERNMENT

Computers, telecommunications, and management science techniques--the three major components of information technology--have had major effects on the management of city governments. Computer technology has been applied in the past to aid the evolution of the dominant city hall with its tendency towards centralization. But computers and other information technologies also can play a major role in the current dual shift towards centralization and decentralization of government. Achieving the technology's potential and avoiding its pitfalls will require that managers:

1. Understand how the technology has fit into the city context in the past and how it will fit into the coming changes in city management.
2. Discern the enabling features of the technology and how these features might fit in or frustrate changes in the management of city governments.

The impact of information technology on these changes will be substantial, but predicting exactly what the impact will be is not straightforward.

Changing Patterns of IT Use in City Governments

The changes that have taken place as a result of the application of IT have been driven by the technology's capacity to provide both precise monitoring and precise control of administrative behavior in the government. Future changes will build upon the changes that already have accrued from the use of information technology in managing the metropolis, or

those that are imminent from its use. A brief review of two major eras of information technology use will provide a base for understanding these changes.

The first era, which began in the early fifties and extended to the early eighties, was oriented around the advantage provided by the computer in facilitating the role of government as an efficient manager of basic urban services. Information technology was applied mainly to the internal operations and decision making processes of government and, in cases like those noted above, to improving the performance of the city itself. Consequently, the effects of the technology on decision making, organization structure, and politics were also mainly internal, and appeared in the form of quicker, more informed decisions, and stable government size and structure despite greatly increased service demand. Bureaucratic politics became oriented around who would control and who would have access to "computer" and "information" resources.

The impact of computerization on the city's executive leadership was slight. It required them to provide moral and financial support for the introduction and expansion of computers in the functional departments, make procurement decisions about computing equipment, determine where and how the activity should be organized within city hall, settle periodic computing disputes between the functional departments over priorities for computer use, and handle the complaints from citizens caused by occasional foul-ups in the government's early billing systems.

[Insert Figure 1 Here]

The second era, which began in the early eighties and will extend beyond this century, is oriented towards the strategic advantage provided by information technology in facilitating the development of new economic activity and new physical form in cities, and in facilitating improved management practices. This era centers on information technology in all its forms and is particularly distinguished by the opportunities for application of the technology outside government to relationships between government and its citizens, individual and corporate clients, and other governments.

City managers now have the opportunity to use the technology to reinforce the decentralization of service delivery while simultaneously reinforcing the centralization of planning and control over services, to enhance citizen participation in neighborhood decision making while strengthening city management control over city-wide policy matters, and to increase the competence of the city bureaucracy while insuring its responsiveness to clients and to city-wide policy.

Several evolving features of information technology are especially important:

1. Change in the economics and capabilities of computers;

2. Linkage of computers with telecommunications networks and with powerful data management software;
3. Linkage of information systems with management science techniques.

Changes in the performance and cost of computers have made it economically feasible to distribute the technology more broadly within and beyond the bureaucracy, thereby enhancing flexibility with regard to how to organize. The change in technology is only an enabling factor but critical in what it enables.

The change in cost of the technology has probably been the most dramatic feature. Computing power has continued to follow Moore's Law which states that the ratio of performance to price of microprocessors will double every 18 months. This continued doubling has put an incredible amount of computing power in the hands of today's users. Today's desktop microcomputers have the computational power of a mainframe computer of a decade ago. This ongoing change in the economics of the technology is resulting in a major shift among organizations from investment in labor to investment in capital. Kraemer and Norris (1994) indicate that city governments were spending three percent of their operating budgets on computing in 1993. The use of PCs has spread especially rapidly. While the number of mainframes and minicomputers in U.S. city government doubled from 1987 to 1993, the number of PCs increased twentyfold (Figure 2).

[Insert Figure 2 here]

Associated with changes in the economics of computers have been radical changes in the form and function of computing. The changes in size, type and performance of computers, for example from mainframes to minicomputers to personal computers, means that government now has much greater flexibility in the choice of technologies to do a particular job. Personal computers put computing power in the hands of individual users, who no longer have to depend on central computing systems for computation and data storage capacities. Packaged client-server applications are replacing custom mainframe software and allowing integration of PCs with each other and with central computer systems in ways that provide powerful tools to the end user. In addition, the advent of notebook computers gives workers and managers the ability to take those tools wherever they go. A social worker can carry case files into the field, an engineer or construction manager can carry project information to the job site, and police officers and fire fighters can carry computers in their vehicles to a crime scene or fire. Simply by plugging into a telephone line or a wireless communication system, these workers can access information in their offices or in a central computing facility.

The linkage of computers with telecommunications networks (e.g., telephone, broadcast television, cable, fiber optics, satellites, etc.) can do more than expand the computing reach of city workers. It can also make it possible to extend the technology beyond the bureaucracy and to directly link up to corporate, household, and individual clients. The availability of online computing services and access to the Internet offer a whole new realm of possibilities for providing citizens with access to information and for enabling citizen input into the decision making process.

The linkage of computers and telecommunications with management science techniques facilitates the application of information to complex decision problems. 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 (Kraemer and King, 1986).

The linkage of IT with management science has more recently focused on the reengineering of organizational functions, a term popularized by Hammer and Champy (1993), or "reinventing government," the phrase used by the Clinton administration for its efforts to improve the efficiency of the federal government. The common theme in these approaches is that the value of IT to organizations depends mostly on how the information systems function is integrated into the broader management processes of planning, decision making, program implementation and evaluation. IT is most 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 carry out poorly designed existing procedures more efficiently, the benefits to the organization will be minimal.

Information Technology and Organization Structure

Most of the debate about IT and organizational structure has focused on whether application of IT results in the centralizing or decentralizing of decision making in government organizations. 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 IT *per se* is neither a centralizing or decentralizing influence. The context in which IT 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, IT tends to reinforce existing tendencies and by itself is not likely to affect organization structure in significant ways.

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.

IT and the Functioning of City Governments

The changes in information technology economics and capabilities have interacted with the changing pattern of city government in a number of ways. We consider the effects of these relationships by examining four specific areas in which the new technology interacts with the evolving pattern of city government:

1. Flexibility in delivery of services
2. Closer linkage of city government with citizen and corporate clients
3. Improved decision making processes
4. Bureaucratic innovation with regard to computer use

Flexibility in delivery of services

Greater flexibility with regard to how to organize will facilitate decentralization of government activity without loss of managerial control in the traditional city hall. For example, the delivery of many social urban services is oriented around neighborhood casework. The use of computers in the management of such casework can support decentralized access to centrally shared information about available government services and eligibility requirements that can be used directly by citizens and by bureaucrats in counseling citizens, targeting them through the service system, and tracking their progress. These same data, plus the aggregated data on citizens obtained by the bureaucrats in assisting them, can be used by city management to analyze service delivery needs, the cost of programs, the quantity and quality of services distributed to different neighborhoods (or racial, ethnic, socioeconomic groups), and the relative effectiveness of different functional departments in the bureaucracy. In turn, this information can be used by city management to redirect services as needed.

Closer "linkage" of city government with citizen and corporate clients

Information technology provides new opportunities for creating stable and mutually beneficial bonds between government and its citizen and corporate clients. City governments can develop better relationships with citizen and corporate clients through strategic use of information systems to give citizens and corporations access to government information. For example, cities can directly share the public data in their real property information systems with title insurance companies, real estate agents, property appraisers and developer-builders, thereby reducing the costs of doing business for these firms and raising revenues for the government by collecting fees for access to the data.

Cities are also better able to refine the means by which citizens pay for the government services they receive. Traditionally, most revenues for the city have been collected through tax levies and placed into a general fund from which services are supported. A few services such as water and trash collection have been charged directly to citizens. Information technology makes it possible not only to target services precisely to those citizens who might want them, but to bill citizens directly for certain services they use. This is already happening in the United States, where declining revenues in city governments have made it necessary for many cities to impose "user fees" for services formerly provided by the general fund. The billing for these user fees is being integrated into the routine billing for water, trash collection and other services with a billing tradition. Such tailored response to demand in the form of both marketing services and billing for services provides local governments with opportunities for revenue generation never before available.

A more recent trend is the development of the national information infrastructure (NII) and the associated trend to put government "online." The early phases of this trend are already underway, in a number of forms. Cities have installed information kiosks in public buildings to

direct citizens to information or services. Similar facilities are being installed in airports and other transportation centers to provide information to travelers and visitors. More significant is the creation of free public networks for citizens to have access to information or register their views on public issues. Santa Monica, California's public electronic network (PEN) is one example, although the many problems that have arisen with the implementation of PEN should give pause to enthusiasts for electronic democracy.

Improved decision making

Information technology facilitates the use of models and other decision aids in structuring complex choices and assisting communication between relevant interest groups and city management to achieve greater consensus on complex decisions. 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. Computers were found to be 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.

The value of computers in more complex decision making processes is still limited, but is growing. 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. Complex issues, such as what effect different 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) 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, the modeling process at least forces decision makers to state their assumptions explicitly, permitting the debate to be based on quantitative issues.

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.

Bureaucratic innovation with regard to computer use.

Broad distribution of information technology within the bureaucracy will result in greater learning about how the technology can be applied to service delivery and decision making, and innovation with regard to its use by the functional departments. Such innovation will make available new information services and products that look good to citizen and corporate clients while also generating new revenues through fees for service, or collecting existing revenues more efficiently.

Caudle (1990) found that strategies for developing information technologies in the public sector tend to come from middle management, rather than top managers who are often political appointees. Unlike top managers or information systems managers, they are the ones who understand best 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 organization needs and sources of external information appears to put these managers in the best position to drive technology diffusion within the organization and to create new uses of IT to improve government service to clients.

IV. POLITICAL CONSEQUENCES FOR CITY MANAGEMENT

Despite predictions that computers and information technology will produce power shifts and political instabilities (Lowi, 1967) in urban governance, there is little reason to believe that these political consequences will be revolutionary. To date, they have been incremental and subtle and, therefore, hard to discern. Although largely unnoticed, their cumulative effects have been consequential for city governments.

The fundamental question about IT and organizational politics is who gains and who loses from the introduction and use of the technology. 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 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.

Looking at the development of computing in city government over three decades, we can draw four major conclusions about the political consequences to date:

1. Due to the political context of computing innovation, the primary beneficiaries of the technology have been those who own and control it. IT originally was principally a tool for the city bureaucracy rather than the city's managers or its citizens. IT has helped to extend the competence of staff, speed up responses, provide standard responses, and improve their image with citizens. However, as political leaders and citizens have gained access to computing resources, they have been able to use the technology to their own advantage.
2. IT has been used by city management to reinforce political reforms, or to supplant them. IT has been used as managers as a political instrument rather than simply a neutral tool. Not only can computing have political consequences, but it is deliberately used precisely to achieve such consequences. And these consequences stem from the way it is introduced and used more than from inherent features of the technology.
3. The often predicted rise of a new technological elite has not occurred. Rather, computing has tended to reinforce the position of top executives and the dominant political coalition in the government.
4. Political activity has historically been characterized more by resource politics than by information politics, but the latter is becoming more prevalent.

In addition to these conclusions about the political consequences of computing to date, we can draw conclusions about future political consequences of the continued diffusion of information technology for city governments. These areas can be expected to create the following additional political consequences:

1. Greater flexibility with regard to how to organize and deliver services will increase the administrative burden of city management in planning, controlling and evaluating the bureaucracy and resolving city-wide and neighborhood issues.
2. Broader distribution of the technology within the government will result in greater interdepartmental competition for a bigger share of computing and information resources, but greater democratization of access within the bureaucracy overall.

It will enlarge the storehouse of data about the operations of functional departments and neighborhood centers, and will facilitate monitoring and control of these operations by city management.

3. Bureaucratic innovation with regard to computer use has reinforced the professional competence and independence of functional departments vis-a-vis city management. This is because functional managers have been the leaders in developing innovative applications of IT. However, a new generation of computer literate politicians (e.g., Vice-President Gore and Speaker Newt Gingrich) and managers has been coming to power and developing their own innovative uses of IT.
4. Closer linkage of government with citizens can contribute to the political stability of city hall and increase citizen involvement in decision making. However, city management faces new decision making challenges in bringing about such linkages. For example, sharing of public data will require policy decisions about who can have access to what, how, when, where and for how much? It will also require determination of how fees should be set for a public good already financed through taxes, and whether any fees derived should accrue to the departments which collect and maintain the data or whether they should accrue to city management for redistribution. And it will require determination of whether sharing public data violates the conditions under which the data was originally provided by citizens.
5. The greater responsiveness of functional departments to their clientele is creating interest group pressures on city management to allocate a greater share of the city's resources to street level vs. administrative departments. At the same time, it makes such allocation decisions more difficult for city management and enlarges the burden of administrative departments by generating new demands for coordinating the flexible responses of the functional departments, budgeting for flexible response alternatives, and evaluating performance under flexible response conditions.
6. Electronic democracy will decrease the "information float" in decision making processes, thereby restricting the choices available to city management. Models and other decision aids make explicit who wins and loses, thus increasing political conflict among various interests, and potentially limiting the choices of politicians.

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Figure 1. The Role of Information Technology in Government

	1950-1980	1980-2000
Technology	Computers	Computers, telecommunications, and management science techniques
Application	Mainly internal to the government and focused on operational performance of the bureaucracy	Strategic use of information technology; external focus on relation of government to its clients; internal focus on planning and control by city management
Impacts	Productivity in large volume information handling; quicker, more informed decisions about internal operations; stable government size despite greater service demands; bureaucratic politics concerning control of computers and internal use of information	Productivity in shared use of information and direct citizen access to service systems; quicker, more decisions about external services; stable government size despite greater citizen access and increased "tailoring" of services; bureaucratic politics concerning control of systems and use of information

Figure 2. Computing Resources in 6,000 Largest U.S. City Governments

	1987	1993
Mainframes and minicomputers	2,000	4,000
PCs	20,000	440,000
IS Staff	20,000	40,000