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The impact of information technology on the middle management workforce: An empirical investigation

Pinsonneault, Alain, Ph.D.

University of California, Irvine, 1990

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UNIVERSITY OF CALIFORNIA

IRVINE

The Impact of Information Technology on the Middle Management Workforce: An Empirical Investigation

DISSERTATION

submitted in partial satisfaction of the requirements for the degree of

DOCTOR OF PHILOSOPHY

in Administration

by

Alain Pinsonneault

Dissertation Committee:
Professor Kenneth L. Kraemer, Chair
Professor John Leslie King
Professor Lyman W. Porter

1990

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Committee Chair

University of California, Irvine

1990

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Dedication

This dissertation is dedicated to the persons closest to me:
my wife, France, my daughter, Alexe, my parents, Fernande and Normand,
and my sister, Anne, whose love and support made it possible,

and

to my sister-in-law, Claire Lafresnière,
who lightened the life of so many of us in her too short journey.

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Acknowledgments

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I am indebted to the other members of my committee, John Leslie King and Lyman W. Porter, for their suggestions, constructive criticisms, and support. In particular, I want to thank them for the numerous insightful discussions we have had together and for the unique perspective they provided.

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Finally, I want to express my great appreciation to my family. My wife, France, has provided unfailing support, encouragement, and help, for which I am truly and deeply grateful. My parents provided the environment, and the emotional and material support that stimulated my pursuit of a career devoted to research and teaching. And my beloved uncle Philippe reinforced the values my parents had promoted and provided precious advice, support, and encouragement.

All these individuals are very important to me. Whatever I have accomplished would not be the same without the respect and support of those around me. To each, I say:

Merci beaucoup.

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Curriculum Vitae

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Recipient, Development Leave for Doctorate Studies, Ecole des Hautes Etudes Commerciales de Montréal (1986-1989)

Publications

Journal articles

The impact of technological support on groups: An assessment of the empirical research. (1989). Decision Support Systems, Special Issue on Group Decision Support Systems (with Ken Kraemer), 5, 197-216, 1989 .

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Book chapter

Technology and Groups: Assessment of the empirical research, in Jolene Galagher, Robert E. Kraut, and Carmen Egido (eds.), Intellectual Teamwork: The Social and Technological Bases of Cooperative Work, Hillsdale, N.J., Lawrence Erlbaum (with Ken Kraemer), 1989.

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Working papers

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The survey research strategy in studies of information systems: Review and critique, Graduate School of Management, University of California, Irvine (with Ken Kraemer), 1989.

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Abstract of the Dissertation

The Impact of Information Technology on the Middle Management Workforce: An Empirical Investigation

by

Alain Pinsonneault

Doctor of Philosophy in Administration

University of California, Irvine, 1990

Professor Kenneth L. Kraemer, Chair

Technology is a major force of organizational and societal change. This dissertation focuses on a particular kind of technology, information technology, and on a particular aspect of organizations, organizational structure. More precisely, this dissertation studies the impact of information technology on the number and roles of middle managers in organizations.

This study uses a mixed research design. The survey collected data with questionnaires in more than four hundred U.S. city governments. Data are analyzed through a hierarchical regression approach with a moderator variable. The case study collected data with some thirty in-depth interviews in two cities. A conceptual framework and five hypotheses derived from it are thus tested.

It was found that the structure of computing decision authority and the structure of organizational decision authority interact together and moderate the impact of information technology on the middle management workforce. What impact information technology has is fundamentally determined by who controls computing and what interests are being served, and, to a lesser extent, by what the roles of middle managers are. In particular, it was found that overall, information technology increases the number of middle managers. However, by disaggregating the level of analysis on the two moderator variables, it was also found that the overall effect is in fact made of a set of opposing impacts. Information technology decreases the middle management workforce when top managers control computing. Information technology increases middle management when middle managers control computing and their roles are mostly unstructured and decisional. It was also found that the reduction in the middle management workforce occurs in public-related departments.

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The information technology impact materializes through the "substitution" mechanism. Information technology creates slack resources at the middle management level, which, depending on the foregoing contingent factors, are substituted by either (a) an expansion of middle managers' attention to the unstructured decisions and an increase in the importance and number of middle managers in the organization, or (b) a consolidation of middle managers' jobs and an expansion of the operations employee workforce.

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Chapter I

Information Technology, Organization, and Society:

The Second Industrial Revolution

We may view a cultural system as a series of three horizontal strata: the technological layer on the bottom, the philosophical on the top, the sociological stratum in between. These positions express their respective roles in the culture process. The technological system is basic and primary. Social systems are functions of technologies; and philosophies express technological forces and reflect social systems. The technological factor is therefore the determinant of a cultural system as a whole. It determines the form of social systems, and technology and society together determine the content and orientation of philosophy. White, The Science of Culture, p. 366

In acquiring new productive forces men change their mode of production; and in changing their mode of production, in changing the way of earning their living, they change all their social relations. Marx, The Poverty of Philosophy, p. 109

No social, human, or spiritual fact is so important as the fact of technique in the modern world. And yet no subject is so little understood. Ellul, The Technological Society, p. 3

It is clear from these quotations that technology is a major force of social and economic change. White, Marx, and Ellul view technology as the fundamental determinant of society. A change in technology alters the very essence of social and economic structures of society. However, as Ellul stresses, we lack understanding of this fundamental phenomenon.

The broader context of the present study is precisely to provide a better understanding of the technological phenomenon in society. In particular, this

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study focuses on how information technology (computers, information systems, and related telecommunication devices) alters the way organizations structure themselves. This introductory chapter discusses the importance of studying the relationship between information technology and organizations and how such a focus is likely to provide insights into broader IT impacts on society in general. It begins by drawing some parallels between the ways production technology and information technology induce societal changes.

Technology and Society: The First and Second Revolutions

History shows the extent to which technology causes significant societal changes. The development and perfection of machine or production technology initiated the first industrial revolution:

> *The invention and diffusion of machinery in the textile manufacture and other industries created a new demand for energy, hence for coal and steam engines; and these engines, and the machines themselves, had a voracious appetite for iron, which called for further coal and power. Steam also made possible the factory city, which used unheard-of quantities of iron (hence coal) in its many-storied mills . . . And all of these products--iron, textiles, chemicals--depended on large-scale movements of goods on land and on sea, from the sources of the raw materials into the factories and out again to near and distant markets. The opportunity thus created and the possibilities of the new technology combined to produce the railroad and the steamship, which of course added to the demand for iron and fuel while expanding the market for factory products.* (Landes [1969], p. 3)

The important point Landes makes here, made also by Peitchinis (1983), is that machinery alone was not sufficient to revolutionize society. Rather, the steam

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engine had to be "managed" into integrated production and transportation systems. The integration of the steam engine into scores of interrelated processes and activities changed the nature and the dynamic of the industrial system, and it is the industrial system that revolutionized the economy and society at large.

A long tradition of research in organization theory shows that production technology has been and is still one of the major factors affecting the ecology of organizations and of society (Bartley, 1986; Blau, McHugh, Fable, McKinley, and Tracy, 1976; Blau and Schoenherr, 1971; Child, 1972; Collins, Hage, and Hull, 1988; Harvey, 1968; Hickson, Pugh, and Pheysey, 1969; Woodward, 1965). The industrial society, however, witnesses the emergence and widespread usage of a new technology, the information technology (IT), the object of which is the replacement of human information processing and intellectual activities. In the evolution of industrialism, the steam engine was the instrument that initiated the revolutionary process. In the on-going or pending information technology revolution, the computer is the catalyst of pervasive changes in organizations and societies. However, as with the steam engine in the industrial revolution, the computer is only an instrument and is not by itself sufficient to significantly alter organizations and societies. Rather, it is the integration of computers into organization-wide information systems, and the integration of these information systems into inter-organization information systems that will change radically the fundamental structure and essence of modern organization and of society at large.

This point is important because it shows the inadequacy of using a unidimensional partial epistemology in efforts to understand IT-induced

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organizational and societal changes. Understanding IT, or even its usage by independent actors, and understanding managerial action and volition are not sufficient alone. IT is the necessary instrument that permits organizational and societal changes, but management action is needed to integrate IT into intra-organization information systems and inter-organization information systems. Hence, both perspectives are necessary, but neither one alone is sufficient to provide significant understanding of how and why IT changes organizations and societies.

The observation of Landes (1969) and Peitchinis (1983) that technology needs to be integrated into scores of interrelated processes in order to have a significant impact is also important because it indicates that the impact of IT on society is still best studied at the organization level. The evolutionary process of IT is only in its infancy. Several organizations have integrated information systems; however, only a few organizations use inter-organization systems. Consequently, the impact of IT on society is only minimal, and hence difficult to analyze. Two other factors favor an organization level approach. First, the penetration of IT into and across organizations is the source of broader societal changes. Therefore, studying the impact of IT at the organization level permits a more detailed and precise understanding of both the dynamic and the nature of the phenomenon. Second, the interaction between IT changes and societal changes is too broad and much too complex to be analyzed directly in any one study, especially given our limited present understanding. It needs to be partitioned out into smaller, more easily amenable parts.

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Information Technology and Organizations

Three main aspects of modern organizations have been studied in relation to IT: quality of work, unemployment, and organizational structure.

Quality of Work

The stream of research on the quality of work has focused on changes IT brings to how people earn a living in organizations. Two dimensions have been studied extensively. The first is the effect of IT on the *worklife and social interactions* of organization members. For example, does IT favor a more regimented and a more streamlined organization of work (Kling and Iacono, in press). The second dimension is how IT affects the *job content and satisfaction* of organization members. For example, does it strip jobs of their intellectual content ("deskilling"), or does it increase their intellectual content ("skilling").

Unemployment

The second major aspect being studied is the effects of IT on unemployment. This stream of research is reflective of the fear that IT will create long-term, structural unemployment, or at best, that it will create temporary unemployment and permanent job displacement. Studies of this stream of research analyze the degree to which IT eliminates jobs at the organization level and then aggregates the results to the societal level.

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Organizational Structure

The third major stream of research explores how IT affects organizational structure. This focus of attention is very important because organizational structure largely determines the quality of worklife and unemployment. For example, an organization with an organistic structure facilitates work in small groups and social networks, and permits a more complete and flourishing social life than an organization with a mechanistic and regimented structure. Similarly, an organization with a very tall and narrow line of hierarchy favors the employment of line managers over staff professionals. Consequently, the study of the impact of IT on organizational structure is likely to provide insights into the effect IT has on other dimensions of organizations and societies.

Three aspects of organizational structure have been studied extensively in relation to IT. First is the *concentration of decision authority*. This stream of research can be traced back to Leavitt and Whisler (1958), who predicted that IT would re-centralize decision authority. They argued that IT permits top management to have easier access to more information and also to monitor lower level activities more closely. However, there is also evidence that IT decentralizes decision authority as it permits top managers to delegate more authority because they can thereby monitor decisions made at lower levels more easily.

The second major stream of research is the impact of IT on the *communication patterns* in organizations. IT, by its mere nature, creates new

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information channels and dissolves old ones. This rerouting of information may affect the roles of different actors in organizations.

The third major aspect of structure being studied is the *occupational profile of middle-level managers*,[1] which is the focus of the present study. This stream of research can also be traced back to Leavitt and Whisler (1958), who contended that IT would eliminate middle managers. Their main argument was that middle managers are the communication channel between top and operations level managers and that this could be best performed by IT. As will be seen in Chapter 2, while there is some evidence supporting Leavitt and Whisler's contention, there is also evidence for an opposite view. IT was found to increase the number of levels of line management, to enhance decision making by middle managers and to strengthen their authority, and to increase differentiation into multiple departments. This contradictory argumentation and the empirical evidence supporting it gave rise to a long-standing debate in MIS over whether IT increases or decreases the number of middle managers. Numerous studies have been conducted on this subject for the last thirty years, but it remains one of the MIS issues furthest from resolution.

The focus on middle managers is important for four additional reasons. First, because middle managers are the core of modern organizations (Chandler, 1977), a change in their occupational profile is likely to affect their very essence. It is likely to modify the concentration of decision authority, to alter communication structures of organizations, and to refocus the attention of top and operations managers. A substantial decrease in the number of middle

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managers might facilitate greater horizontal centralization (bringing business units together) and vertical centralization (bringing decision authority to the top of the hierarchy). The reduction of middle management might require top managers and operations managers to deal directly with each other. Also, a reduction of middle managers might refocus the attention of top managers from being mostly outward, long term, and future oriented, to being increasingly inward, short term, and present oriented. Finally, this scenario also implies a greater understanding and use of information technology by top managers because it must become their main instrument of communication and control given the reduction of middle managers.

On the other hand, a substantial increase in the number of middle managers might consolidate their roles as the intra- and inter-organization information gatekeepers, making them the center of several communication networks. Top management might delegate more decision authority to middle managers. By delegating, top managers might be able to increasingly focus on outward and future oriented activities, leaving operational and control aspects to middle management. Also, middle managers would perform more "real" managerial functions than before, interacting with outside organizations and having greater decision authority and responsibility. Consequently, understanding the impact of IT on middle managers may lend insights about the wider organization changes generated by the technology.

The second reason for focusing on middle managers is that the magnitude of change in the occupational profile of middle managers attributed to IT is very

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important. IT is said to have reduced middle managers by 10%,[2] or by about one million managers in the U.S.A.[3] This is very significant in light of the fact that the IT revolution is only in its infancy. The one million jobs that have been lost are likely to be concentrated in the relatively few leader organizations that have integrated information systems. And as such, the one million job loss is only a harbinger for larger impacts yet to come as the IT revolution further materializes.

Third, understanding how IT affects the number of middle managers might provide better understanding of the value of IT to organizations. Justification for IT applications is often made on the basis of its potential to reduce staff. Understanding how IT affects the number of middle managers might provide more precise estimates of the benefits attributed to IT based on its capacity to decrease the number of people needed to perform a job.

Finally, a change in the occupational profile of middle managers has significant implications for management education. A significant increase or decrease in the number of middle managers will either expand the existing market for business graduates or shrink it considerably. Therefore IT might provide an opportunity for business schools to grow and have an even more significant role in society. However, it might also force them to rethink the educational system and adjust it to a changing market where middle managers are no longer needed.

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Research Objectives and Contributions

The broad goal of this study is to extend present knowledge of the impact of IT on middle managers. More precisely, my objective is twofold. It must be determined whether IT increases, decreases, or has no significant effect on the number of middle managers. Secondly, the reasons for this impact must be identified through an analysis of the process of change in the occupational profile of middle managers. In particular, my aim is to determine how the IT intervention affects the roles of middle managers in organizations.

This study's contribution is to transform the present empirical paradox into a solvable puzzle. It goes beyond previous studies in that it recognizes and places the arguments underlying them in perspective and uses these arguments as its theoretical foundation. Also, this study uses a more encompassing and complete research approach than most previous studies. Consequently, it generates more comprehensive and detailed knowledge about the impact of IT on middle management and refines the analysis of the organizational impact of IT. In addition, the present study raises and further systematizes the prospect of a contingency explanation of the IT impact on middle managers. This is one of the few studies to explicitly take into account factors that might affect the IT impacts on middle management. It extends the findings of Pinsonneault (1988) and of Kraemer, King, Dunkle, and Lane (1989) which stressed the significance of management action and volition. Following from these contributions, the present knowledge of the IT impact on middle managers is extended. As will be seen in

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Chapter 2, most present studies are based on flawed methodology and the knowledge acquired to date is based on speculative, unsystematic, and anecdotal grounds. This study provides findings based on more systematic and rigorous research.

The next chapter reviews the research that has been conducted in MIS on the impact of IT on middle managers. It also discusses problems common to most studies and presents the research avenue favored in this study.

The chapters that follow Chapter 2 are concerned directly with the study per se. Chapter 3 presents the theoretical framework developed for studying the IT impact on middle managers and the hypotheses derived from it, and it defines these concepts. Chapter 4 discusses the research methodology of this study and of the larger project of which it is a part (URBIS project). Chapter 5 presents the findings of the survey analysis and Chapter 6 presents the findings of the case study analysis. Chapter 7 presents the "substitution" mechanism and uses it to explain the findings. Finally, Chapter 8 concludes by summarizing the findings and discussing the implications of this study for future research.

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Endnotes

1. As will be seen later, "middle-level managers" is the correct way to refer to the managers (staff and line) at the middle of the organizational hierarchy. However, for clarity and simplicity, we will use "middle managers" from here on.

2. This estimate of 10% is based on personal field work and past studies (Lee, 1964). Also, although researchers do not usually provide this data, their description of the impact of IT leads us to think that 10% is conservative. Byrne (1988) reports that over a third of U.S. middle-level management jobs have been eliminated.

3. This approximation is based on Kay (1974), the 1985-1986 Urban Information Systems Study (URBIS), personal field work, and data from the US Bureau of Labor Statistics, Employment and Earnings (August 1988). In 1988, the US Bureau of Labor Statistics established the number of executives, administrators, and managers in the U.S.A. at 13,416,000. Middle management typically constitutes 50% of the managerial work force, or 7,000,000 managers. A 10% variation represents 700,000 managers. Some experts estimate at more than one million the number of U.S. middle managers and staff that have lost their jobs in the past decade (Business Week, 1988). The Bureau of Labor statistics shows that between 1981 and 1986 almost 500,000 executive, administrative, and managerial workers have lost jobs that they had held for at least three years (Nulty, 1987).

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Chapter II

Literature Review: The Debate

Leavitt and Whisler's landmark article on the impact of IT on organizations (1958) generated a vast amount of speculation and research on how IT might affect middle managers. From the late fifties to today, several authors have put forth arguments on how and why IT reduces the number of middle managers (Burck, 1964; Child, 1984; Drucker, 1988; Geisler, 1986; Malone, Yates, and Benjamin, 1987; Whisler, 1965). Quite rapidly however, scholars have also articulated counter-arguments contending that IT, rather than decreasing middle managers, increases their number substantially (Burlingame, 1961; Foster and Flynn, 1984; Gilman, 1966; Uris, 1963). More importantly, this long-standing debate has also been fuelled by over thirty years of empirical studies that provide support to the two opposing positions. This long-history of argumentation and research has made the issue of the IT impact on the number of middle managers one of the most important unresolved questions in MIS. Contemporary scholars are still puzzled by the problem (Applegate, Cash and Mills, 1988; Drucker, 1988).

This chapter reviews the empirical literature that focuses on the impact of IT on the number of middle managers. To obtain additional grounding, it also includes studies that provide findings relevant to the present study on the impact of IT on the concentration of decision making.[1] In the discussion, studies are

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classified according to their findings regarding the effects of IT on the number of middle managers.

IT as Decreasing Middle Managers

The position that IT decreases the number of middle managers was first articulated by Leavitt and Whisler (1958). Their basic argument is that IT takes over most of middle managers' tasks and reduces the number of layers of line functions at that level. IT centralizes structures horizontally by bringing business units together and vertically by bringing decision authority to the top of the hierarchy. Moreover, they contended that the remaining middle managers shift in two directions. The majority see their jobs become more structured and routine and sink into the operational level of organizations. A smaller portion move up into jobs requiring more creativity and control over decision. The resulting organizational structure resembles an hourglass. The top half contains some high level managers and very few middle managers and the bottom half contains many clerical workers and first line supervisors and a few middle managers. The premise underlying this argument is that middle managers are mostly an informational link between top managers and operations managers and that IT takes over these functions. Therefore, IT permits top managers to bypass middle managers in both upward and downward communication activities. Top managers perceive middle managers as redundant, dispensable, and costly, so they replace them with IT.

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Table 2.1 indicates that several empirical studies on the impact of IT on middle managers and on the impact of IT on the concentration of decision authority support this position. Each is reviewed next, followed by a summary of the commonalities in the findings and by a discussion of the strengths and weaknesses of the findings.

Table 2.1
Empirical Research on the Impact of IT on Middle Managers:
IT Decreases the Number of Managers

Author	Concept		Research Design				Major Finding
	IT	MM	Method	N	Industry	Function	
MM studies							
Hoos (1960)	Operations	Below exe-tive junior grade, at or above sup-ervisor level	Case	19 org.	Cross-industry	Cross-function	- IT integrates functions and groups business units - IT centralizes authority - IT reduces MM
Whisler (1970)	Operations	Not defined	Case	19 org.	Insurance	Cross-function	- IT reduces the number of managerial levels - IT centralizes authority - IT routinizes MM's jobs
Crowston et al. (1986)	Computer conference (1 system)	Not defined	Case	1 org.	Electronic manufac-turer	Comp-ensation & bene-fits	- IT centralizes authority - IT reduces line MM - IT increases staff specialists - IT does not affect the overall number of employees
Brynjolfsson et al. (1988)	Stock of IT capital	Not defined	Sec-ond-ary data	U.S. econ-omy	Cross-industry	Cross-function	- IT increases market coordination - IT increases sales workers - IT decreases hierarchical coordination - IT decreases managerial workforce
DMA studies							
Mann and Williams (1960)	Customer accounts (1 system)	Not defined	Case	1 org.	Electric, light, & power	Accoun-ting	- IT centralizes authority - IT formalizes structures - IT fosters horizontal consoli-dation of business units
Robey (1981)	Manage-ment sys-tems	Not defined	Case	8 org.	Cross-industry	Cross-function	- IT does not affect the distri-bution of authority in most cases - When IT does have an effect, it centralizes authority

MM: middle managers TM: top managers DMA: Decision making authority

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Hoos (1960) studied the impact operation level information systems on office work. Based on interviews with a wide range of office workers (from top managers to keypunch machine operators and union representatives), Hoos concluded that IT centralizes decision authority by integrating functions and by grouping business units. She also found that IT combines middle managers' jobs and reduces the number of middle managers substantially.

Whisler (1970) studied the impact of computerization in 19 insurance companies of different sizes. Personnel in each firm conducted structured interviews under the guidance of an executive who was a member of the group that oversaw the overall study. Whisler found that computerization reduces the number of levels of managers and centralizes decision authority at the top of the hierarchy.

Crowston, Malone, and Lin (1986) studied the effects of a computer conferencing system on two divisions responsible for compensations and benefits as they were merged. They gathered data through face to face and telephone interviews, observations of interviewees using the computer conferencing system, and examination of messages. Crowston et al. found that computer conferencing centralizes decision authority, reduces the number of line middle managers, and increases staff specialists higher up in the hierarchy. However, they noted that computer conferencing does not affect the total number of people in organizations.

Finally, Brynjolfsson, Malone, and Gurbaxani (1988) studied the impact of IT on markets and hierarchy coordination mechanisms in the U.S. economy.

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Econometric models were applied to data on employment categories, firm size, and IT investment from the U.S. Bureau of Economic Analysis covering the 1975-85 period. Brynjolfsson et al. found that IT leads to a shift away from hierarchies toward market coordination. Increases in the stock of IT capital in an industry are correlated with decreases in the number of managers employed and with increases in the number of sales workers. Brynjolfsson et al. also observed a significant learning curve in the impact of IT which can lead to delays of up to five years before the effects are fully felt.

Empirical studies that focus on how IT affects the concentration of decision authority also support the position that IT decreases the numbers of middle managers. Mann and William (1960) studied how the computerization of an electric, light, and power company's one million customer accounts affected its accounting and sales divisions. Based on unstructured interviews with upper, middle, and supervisory levels managers and some of their subordinates, Mann and Williams concluded that computerization centralizes decision authority and formalizes the structure of organizations. They also found that computerization eliminates several more routine and tedious tasks requiring people with relatively low skills, and some higher level jobs involving minor decision. However, the overall job grade levels within an organization are not affected.

Finally, Robey (1981) analyzed the organizational impacts of diverse computer information systems supporting managerial decision in eight organizations (in the U.S.A., Germany, Austria, England, and Denmark). Robey used a comparative case study and gathered data through two structured

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interviews and one questionnaire administered to each respondent of those departments affected by the system's introduction. One unstructured interview with top managers and one with systems developers were also conducted. Robey found that most of the time, computerized information systems are not associated with any changes in the formal organizational structure. Rather, they reinforce existing distribution of authority. However, Robey found that when computerization is associated with organizational changes, it tends to centralize control.

Assessment of the Findings

Overall, the findings of this set of studies converge. IT centralizes decision authority at the top of the hierarchy and formalizes the hierarchical structure. Also, IT was found to reduce the number of layers in the hierarchy, particularly at the middle management level, and to foster horizontal consolidation by integrating functions and business units. The result is a shorter and narrower hierarchy where there are only a few middle managers. How IT affects the roles of the remaining middle managers is not clear. Whisler (1970) found that IT routinizes the roles of middle managers while Mann and Williams (1960) found the opposite.

The validity of the findings of a set of studies does not depend as much on the quality of any one particular study as on the heterogeneity of the research designs and contexts (variables controlled and not controlled), which provides an indication of the general occurrence of the findings common to a particular set of

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studies. Consequently, the more heterogeneous the research designs and contexts in a set of studies, the more valid the findings common to them.

The position that IT decreases the middle management workforce has a reasonable support and seems to be relatively robust. First, the findings were obtained over almost thirty years, from 1960 to 1988. This reduces the possibility that a temporary environmental factor caused the decrease in middle managers. Second, these findings are valid for a wide array of information systems: operation information systems (Hoos, 1960; Mann and Williams, 1960; Whisler, 1970), a computer conferencing system (Crowston et al., 1986), and diverse management systems (Robey, 1981). Third, the findings were obtained across several industries and functional areas.

However, this position also suffers from important weaknesses. First, IT is not clearly defined and operationalized in most studies. For example, Hoos (1960) defines IT as computerization of operations activities. However, she does not specify the nature of these systems: who has access to them, who uses the systems most, or what information they provide to whom. In fact, the classification of the IT in Table 2.1 was actually inferred by the author in several studies. Therefore, it is difficult to understand and determine precisely what IT was studied and how much different technologies really are across the set of studies. An awareness of this heightens the fact that scholars need to define clearly the nature of IT, its usage pattern, its vertical and horizontal distribution in the organization, and how it is measured. Not differentiating IT may blur

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analysis and handicap attempts to understand and to explain how and why IT affects middle managers and organizations in general.

The second weakness of this set of studies is that middle management is not clearly conceptualized and defined. In fact, middle management is defined only in one study (Hoos, 1960), and that definition is questionable. It is doubtful that a first level supervisor, who directly manages operations, plays a similar role to that of a manager just below the junior executive level. Not defining middle management is problematic because the concept of hierarchical levels in organizations is continuous, and middle managers do not form a well defined homogeneous group that can be differentiated easily from top managers and from operations managers. The cutoff point between managers of different hierarchical levels is fluid. Roles are not very different between managers with a small hierarchical gap. In other words, the greater emphasis on operationalization of policies and procedures by middle managers (in contrast to the establishment of policies and procedures by top managers and the execution of policies and procedures by operations managers) is more pronounced at the midpoint of the "middle management" stratum than close to the cutoff points. Therefore, "middle management" might refer to very different realities across studies. Such discrepancies might hinder our ability to make meaningful comparisons of findings across studies and to cumulate knowledge.

The third weakness of this set of studies is that all the studies but Brynjolfsson et al. (1988) are based on case study design within very few organizations. The samples range from one to nineteen organizations. In

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addition, most case studies rely on samples of convenience rather than on samples selected for theoretical reasons. Often, there is no indication of why specific organizations, departments, and respondents are chosen, nor of how they might differ from the population to which findings are generalized. Coupled with the fact that samples were chosen for convenience, the very small samples reduce the confidence we can place in the findings as generalizable to the population of interest.

The fourth weakness is the focus of the studies. On the one hand, in an effort to obtain general findings, three studies include organizations of different sectors. This certainly has the advantage of making inter-industry differences insignificant in explaining differences in computer impacts. However, two of those three studies do not analyze enough organizations to be truly representative. Also, because organizations are so heterogeneous and because our understanding of the organizational impact of IT is so limited currently, the phenomenon studied is often too complex to offer insightful analyses.

On the other hand, the other three studies focus on a single industry. This sector specific approach could provide findings that permit the comparison of results across sectors and enable the determination of whether or not the industry is relevant to how IT affects the number of middle managers. These findings could then be developed into a general theory. However, the three studies using this approach do not explain how and why findings are applicable, or not, to organizations of different industries and to the population in general.

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The final weakness of this set of studies is that the studies do not take into account the functional areas as a factor affecting the impact of IT on middle managers. However, the roles of middle managers--which as discussed in Chapter 3 partly determine the IT impacts--are strongly influenced by variables related to functions (Chapple and Sayles, 1961; Hemphill, 1959, 1960; Stewart, 1967). For example, research shows that production managers perform a greater proportion of decisional roles than interpersonal and informational roles; sales managers perform a greater proportion of interpersonal roles; and accounting managers perform a greater proportion of informational roles (Alexander, 1979; McCall and Segrist, 1980; Mintzberg, 1973). Not taking into account these functional differences may blur findings. No effect might be found when in fact two opposing changes occur in different functional areas, seeming to cancel each other. Or, particular impacts may be thought of as general when in fact they relate only to middle managers of specific functional areas. An example of this is Mann and William's findings that IT decreases the number of middle managers in accounting divisions. This, according to the above discussion, is to be expected because the informational roles are the easiest to computerize. The point made above also limits the generality of Mann and William's findings to accounting divisions only.

In summary, although the studies of this set provide consistent findings that IT reduces middle management and centralizes decision authority, the studies also suffer from serious problems that somewhat limit the confidence that can be placed in their findings. The problems do not discredit or invalidate the findings,

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but they indicate that the empirical bases for the contention that IT decreases middle managers, although real, are weak and need to be supplemented.

IT as Increasing Middle Managers

In complete opposition to the findings of the first set of studies, other scholars argue that IT increases the number of middle managers in organizations and decentralizes decision authority. This, they argue, results in organization structures that resemble a bulging pyramid.

The premise underpinning this position is that middle managers are far more than just information transmitters. Scholars, especially those who have studied managers in depth, argue that middle managers also perform interpersonal and decisional roles. Moreover, they argue that middle managers use processes and information not amenable to computerization. Some also argue that IT, by its very existence, overwhelms organizations with information that needs further processing by middle managers to become endowed with relevance and purpose. This plethora of information increases the number and range of decisions made at middle management level and uncovers details that were not previously known relevant to management decisions. This forces middle managers to make more decisions and to analyze more alternatives in greater depth than before (Burlingame, 1961; Ellis, 1984; Guthrie, 1974; Shaul, 1964; Uris, 1963; Wildavsky, 1983; Wynne and Otway, 1983).

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In summary, the main argument of this position is that IT can replace only a small fraction of the informational roles of middle managers, thus creating slack resources filled by more responsible functions (i.e. the decisional roles). IT enlarges and enriches middle managers' jobs by (a) requiring them to use more knowledge, judgment, and experience, (b) adding to their present activities or replacing some with more responsible functions, and (c) increasing the importance of filtering, organizing, interpreting, and evaluating information.

As might be expected, a significant number of empirical studies that focus on the impact of IT on the number of middle managers and on the concentration of decision authority support this position. Each is reviewed next, and then the body of research is summarized and evaluated.

Table 2.2
Empirical Research on the Impact of IT on Middle Managers:
IT Increases the Number of Managers

Author	Concept		Research Design				Major Finding
	IT	MM	Method	N	Industry	Function	
MM studies							
Lee (1964)	Operations	Not defined	Case	1 org.	Shoe manufacturer	Ping,DP merchandising	- IT decreases clerical manpower - IT increases managerial manpower (especially MM)
Shaul (1964)	Operations	Above 1st line super. and below division managers	Case	8 org.	Cross-industry	Not specified	- IT extends the scope of MM's job - IT makes MM's job more complex - IT raises MM status - IT increases MM's time spent on planning,staffing, and directing and decreases controlling time
Meyer (1968)	Operations	Not defined	Survey	254 org.	City, county, state government	Finance	- IT increases the number of hierarchical levels - IT increases the span of control of supervisors - IT decentralizes authority

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Blau et al. (1976)	Operations	Not defined	Survey	110 org.	Diverse manufacturers	Cross-function	- IT increases the division of labor - IT decreases the span of control of managers - IT increases the number of hierarchical levels - IT increases the managerial workforce
Pfeffer and Leblebici (1977)	Not defined	Not defined	Survey	38 org.	Cross-industry	Cross-function	- IT increases the number of hierarchical levels and the number of departments - IT decentralizes authority
Foster and Flynn (1984)	Communication system	Not defined	Case	1 org.	Auto manufacturer	Environmental activities	- IT permits TM to bypass MM to communicate to lower level managers - IT decreases MM's control over organization info. - IT takes over routine jobs
<u>DMA studies</u>							
Klatzky (1970)	Operations	Not defined	Case	53 org.	State employment agencies	Cross-function	- IT decentralizes authority (cascade effect) - IT takes over routine jobs
Bjorn-Andersen and Pedersen (1980)	Operations (1 system)	Not defined	Case	1 org.	Radio and TV manufacturer	Production scheduling	- IT increases influence of direct users (MM who are the gatekeeper of IT) - IT limits the discretion of both the direct and indirect users (MM)
George (1986)	Operations and mgmt	Not defined	Survey	224 org.	Local government	Cross-function	- IT decentralizes authority (gravity effect) - IT takes over routine jobs

MM : Middle managers DMA : Decision making authority
TM : Top managers

Lee (1964) studied how computerized merchandizing and production planning systems affected the data processing, product planning and specification, and merchandise departments of a shoe manufacturer. Based on personal interviews and comparative analyses of working forces before (1955) and after (1962) the computer installation, Lee found that these computerized information systems decrease clerical manpower by 17%, but increase managerial manpower by more than 22%.

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Also in 1964, Shaul studied how operations level computer information systems affected eight companies of different industries (aircraft, petroleum, electronics, radio and TV, banking, life insurance, finance, and telephone). Based on interviews with 53 middle managers and 14 top managers, Shaul concluded that these information systems extend the scope of middle managers' jobs, make their jobs more complex, and raise their status. Shaul also found that the information systems make middle managers' work involve more planning, staffing, and directing activities, while reducing the time they spend controlling. Overall, he found that no change occurs in the occupational profile of middle managers because computer makes it possible for them to devote more time to functions previously neglected.

Meyer (1968) studied how automated operation information systems affected the finance departments of 254 city, county, and state governments. Through interviews with division heads, Meyer found that the computerized departments have more hierarchical levels and that the first-line supervisors have a wider span of control. These structural changes promote greater decentralization of decision authority.

Blau et al. (1976) studied 110 New Jersey manufacturing companies of different size and different industries. They gathered data through structured questionnaires administered to senior managers, including chief executive officers, heads of production, and personnel managers. They found that automation of various administrative functions (shipping and receiving, quality control, inventory control, marketing, sales, accounting) increases the division of labor and decreases

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the span of managerial control. These two effects increase the number of hierarchical levels and the managerial workforce. They also found that it is the location of computer facilities that governs the locus of decision authority: on-site computers foster decentralization and off-site computers foster centralization.

Pfeffer and Leblebici (1977) studied 38 small manufacturing organizations of different industries. They collected data by questionnaires and telephone interviews with chief executives. Pfeffer and Leblebici found that the extent of computerization is correlated with an increase in the number of hierarchical levels and in the number of departments. Computerization also favors the decentralization of decision authority.

Finally, Foster and Flynn (1984) studied how integrated management information systems (intra-organizational communication, electronic data storage and retrieval, and personal computing resources) affected the 180 employees responsible for policy-development, research, and regulatory compliance at General Motors. Based on anecdotal evidence, they concluded that the information systems they studied permit top managers to bypass hierarchical communication channels and to obtain direct access to information otherwise controlled by middle managers. Also, these information systems facilitate lateral networking that ties together individuals from different parts of an organization. These two effects create slack resources, which, they contend, could in fact result in the consolidation of jobs at managerial and professional levels and in decreases in the number of skilled managers and professionals. However, Foster and Flynn argue that this effort to increase organizational efficiency is likely to happen only

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in poorly managed organizations. Where organizations gain more by recovering salary savings than by reinvesting time savings, the managerial and professional ranks are failing to return on the investment made by the firm. They content that in well-run organizations, the greatest organizational payoffs will come from reinvesting the time savings and using the flexibility generated from it to meet the organization's changing needs.

Empirical studies that focus on how IT affects the structure of decision authority also support the position that IT increases the number of middle managers. Klatzky (1970) studied the effect of computerization on the locus of decision authority in the 53 state employment agencies in the U.S. Using case study analysis, Klatzky found that the extent of automation leads to greater decentralization of decision through what she calls the cascade effect. Automation, she argues, typically frees lower level managers from the more routine responsibilities. As the superiors recognize the slack resources thus created, they delegate some responsibilities down, which in turn frees the higher level managers. The process repeats itself up to the highest level.

Bjorn-Andersen and Pedersen (1980) studied the computerization of production and scheduling systems in a radio and television manufacturing company. Data on the systems were gathered through interviews with systems designers. Data about organizational matters were gathered through two structured interviews and one questionnaire administered to each middle manager, and through observation and written materials. Bjorn-Andersen and Pedersen found that computerization increases the influence of the gatekeepers of

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IT (middle managers who are direct users) and limits the discretion of both direct and indirect users (middle managers).

Finally, George (1986) studied the impact of automation on the concentration of authority in 224 city governments. Data were gathered through three questionnaires, two of which were filled by the manager of each data processing installation, and one of which was filled by the city manager. George found that the degree of sophistication of computerized information systems is positively correlated with greater decentralization of decision authority through what he calls the gravity effect. Like Klatzky, George argues that IT frees the lowest level managers from the more routine tasks. However, George contends that decision authority is not pushed down by higher level managers (Klatzky's cascade effect), but rather pulled down by lower level managers searching to increase their authority.

Assessment of the Findings

Overall, the findings of this set of studies converge. IT was clearly found to decentralize authority at the middle management level. Also, IT increases the number of hierarchical levels and the number of departments. IT leads to the proliferation of middle managers and it makes their jobs more complex and broader in scope.

These findings have strong support in the set of studies. First, they were obtained over a period of more than twenty years. This, here again, reduces the probabilities that the findings result from a temporary environmental factor.

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Moreover, the findings are based on both in-depth case studies of a few organizations and nation-wide surveys of very large samples. In addition, the research design of most studies of this set is quite rigorous, except Bjorn-Andersen (1980), Foster and Flynn (1984), and Lee (1964). In those cases, the samples are made of one organization that was chosen for convenience purposes. The authors do not explain why the particular organizations were chosen and how this choice limits the generality of the findings.

The second strength of these findings is that they were obtained in diverse sectors and in diverse functional areas. Most studies are sector-specific, but as a group, they cover a wide array of industries. Most studies of the previous set focused on multiple sectors. As discussed earlier, because of our limited understanding of the IT impact and because of the great complexity inherent in doing cross-sector research, the combination of sector-specific studies focusing on different industries provides stronger empirical evidence than the combination of cross-sector studies.

The studies of this set suffer from two weaknesses. First, all of the studies but one focus on operations information systems. And the study that does incorporate different information systems (Foster and Flynn, 1984), does so by lumping them together without recognizing the fact that they are likely to affect middle managers differently. Foster and Flynn (1984) lump together intra-organizational communication systems, electronic data storage and retrieval systems, and personal computer systems. However, because personal computer systems provide support markedly different from the two communication

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technologies, their impact is likely be different. Yet, Foster and Flynn do not account for this. The limited focus of this set of studies on operations information systems greatly hinders the generality of the findings, because different ITs are likely to affect middle managers differently. The second problem of these studies is that, here again, middle management is not clearly conceptualized and defined. Only Shaul (1964) defines what he means by middle managers.

In summary, this body of research provides stronger empirical evidence that IT increases the number of middle managers than the set of studies indicating that IT decreases middle managers. There are more studies in the former set, and most studies were conducted in a more systematic fashion. They also cover a wider range of sectors and functional areas. These observations, however, do not invalidate the finding that IT decreases middle managers but simply indicate that the finding that IT increases middle managers has stronger support. In fact, there is sufficient evidence beyond that offered in these studies to indicate that IT can and sometimes does decrease the number of middle managers.

Resolving the Contradiction between Studies: A Contingency Approach

The next questions to be raised given that IT increases and sometimes decreases the number of middle managers are when and why IT decreases the number of middle managers and when and why it increases their number. The

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best way to disaggregate the empirical research meaningfully is to determine what contingent factors were found to moderate the impact of IT across a set of studies sharing common findings. Several factors have been proposed in the theoretical literature: organization size, industry type, degree of prior routinization of work, degree of dependence upon high-skilled work force, patterns of information usage and information flow associated with the technologies in use, and nature of the environment (stability, complexity) (Attewell and Rule, 1984; Carter, 1984; Klatzky, 1970; Leifer and McDonough, 1985; Pfeffer and Leblebici, 1977). However, very few studies take into account those contingent factors and even fewer studies report the effects of contingent factors or provide information about them. It is often assumed that IT is the single most important factor, other than size, affecting the number of middle managers.

The avenue used in previous studies by scholars to get at these factors is to determine the fundamental models of change favored by the scholars across studies as best fitting the reality analyzed. As will be seen, this epistemological choice, conscious or not, frames the research around certain factors and also limits the importance of other factors.

Two Models of Change in Organizations

Kraemer et al.'s (1989) typology of models of organizational change enables a better grasp of the change process that scholars have observed in middle management.

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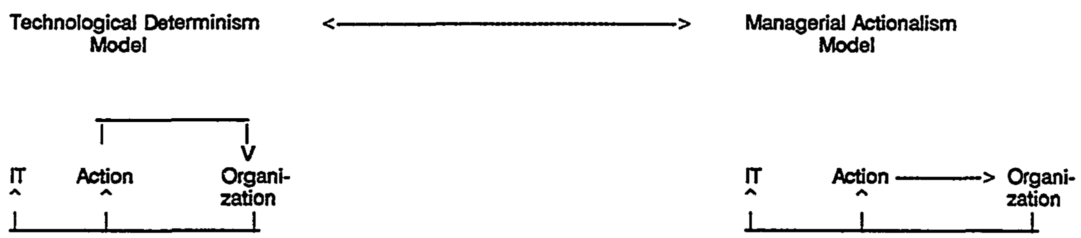
Figure 2.1
Models of Change in Organizations



The technological determinism and managerial actionalism models of change are the two fundamental models that are drawn upon in this empirical literature. The technological determinism and the managerial actionalism models provide radically different conceptions of an organization and how its components interact and influence each other. Consequently, depending on which model one favors one, is likely to focus on certain aspects of the change process and give greater importance to certain factors than to others. This is illustrated in Table 2.3 below and elaborated next.

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Table 2.3
Basic Models of Change Used in the Analysis of the Impacts of IT on Middle Management

	Technological Determinism	Managerial Actionalism
Organization	* Mechanical device * Set of precise procedures that control actors	* System of individuals with unequal power, and divergent interests
Determinants of structures	* Exogenous forces (information technology)	* Endogenous forces (managers' action)
Nature and roles of management (general and middle management)	* Reactive, fit the organization to existing external conditions * Middle management is the communication link between top and operations managers	* Proactive, energizing force that shapes the organization structure * Middle management is a political player who uses and manipulates information to its advantage
Information technology	* Emerges and evolves according to its internal logic	* Malleable tool, can fit different structures
Information technology-structure relationship	* Technology—> structure (tech. alters struc.) * Single and constant impact of technology on middle management	* Technology—> structure (struc. influences tech.) technology is chosen and used to fit the struc. * Multiple and varied impacts of technology on middle management
Impetus for innovation	* Functional superiority	* Actors' perception of opportunities to promote personal interest

Technological determinism model of change. Technological determinism draws upon rational economic theories of capital labor substitution and comparative advantage. In its pure form, the logic of this model is that IT and managers are two means to perform the functions required at the middle level of the hierarchy and that the most efficient means will be chosen over the other.

The technological determinism model conceptualizes organizations as a set of precise procedures that controls the mobility, and coordinates the efforts of several individuals or groups toward the attainment of common organizational objectives. In its pure form, technological determinism assumes that action does

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not significantly alter organizations. Rather, actions are mostly constrained and determined by organizations (the absence of a direct arrow and feedback arrow). Organizations are influenced, and their structures mainly determined by exogenous forces which are only partially controllable by organization members. Organization actions and behaviors are shaped by a series of impersonal mechanisms that act as constraints on actors (Astley and Van de Ven, 1983). Managers are basically reactive; they adapt organizations to the exigencies that confront them. The focus of managerial actions is not on choice but instead on gathering correct information about relevant contingent factors, interpreting it, and evaluating the consequences of responses to different demands (Astley and Van de Ven, 1983). The success of an organization largely depends on the appropriateness of the fit between its structure and contingent factors. Middle managers are conceptualized as the communication links between top management and operations management. They transmit and "translate" decisions made at the top downward, and they report anomalies occurring in the operations upward.

As the arrows in Figure 2.1 illustrate, IT is the fundamental intervention in the ecology of organizations. IT is not customized to the requirements and structural characteristics (control, dominance, power) of specific organizations. Rather, IT is assumed to emerge and evolve according to its own internal logic. Introduction and usage of new technology arise because of its superiority in resolving organizational problems. IT does not necessarily fit organizations. Rather, organization structures are adapted to IT. New IT that alters information

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access and control might modify the distribution of power among various organization members, trigger social dynamics, and create new dependencies while also dissolving old ones; hence it would induce structural changes (Attewell and Rule, 1984; Bartley, 1986; Keen, 1981; Markus, 1984; Markus and Pfeffer, 1983; Pfeffer, 1978; 1981; Wildavsky, 1974; Wynne and Otway, 1983).

Research using this perspective focuses on identifying and trying to understand the external forces that affect organizations. In MIS, IT is assumed to be the most important single factor affecting organization structures. Attention is mainly focused on the role of middle managers on the one hand, and on the technical characteristics of IT on the other hand. In its pure form, technological determinism understands the IT impact by analyzing what middle managers do and what IT can do and by comparing them in terms of cost and efficiency.

The essence of the technological determinism arguments for the impact of IT on middle management can be summed up as follows. Middle managers retain those functions in which they have comparative advantage, and computers take over those functions where they have comparative advantage. Hence, IT takes over most informational and structured decisional activities and few, if any, unstructured decisional activities and interpersonal ones. Decreases in the number of middle managers occur in organizations where the emphasis of middle managers is on processing information and making structured decisions. On the other hand, increases in the number of middle managers occur in organizations where the emphasis of middle management is on unstructured and

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unstandardized decision. IT takes over only a very small portion of their jobs, leaving them more time to perform "real" managerial tasks.

The technological determinism model of change was described above in its "pure" form. Scholars have long recognized its frequent inadequacy in such an extreme form and have used hybrid versions. However, it is clear from the focus of attention of research and from the explanations provided for the findings that strong biases favoring technological determinism exist and that many scholars give very little attention and importance to alternative models of change. The work of Pfeffer and Leblebici (1978) is an example of an approach favoring a more deterministic model. The basic argument underlying their research and their explanations of the findings is that "IT substantially alters the mechanisms and the nature of organizational coordination and control, and, therefore, has direct causal effect on the structure of the organization" (p. 247). They argue that IT has two fundamental effects. First, IT enhances managers' information processing and handling capacity, which permits managers to control and coordinate more complex, differentiated organizations. Consequently, IT is positively associated with both vertical and horizontal differentiation in organization. Second, IT provides more rapid and more comprehensive feedback concerning aspects of organizations and managerial performance. This, Pfeffer and Leblebici argue, facilitates the delegation of decision authority to lower level participants and the increase in the number of departments and hierarchical levels. For Pfeffer and Leblebici, change in organization structure is fundamentally determined by the technical capabilities of IT, which favor greater decentralization of decision

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authority. Managerial action (who controls computing, which IT is chosen by the dominant coalition, and whose interests are being served) is assumed to have an insignificant effect, if any, and is therefore excluded almost totally from the analysis.

Managerial actionalism model of change. The managerial actionalism model of change draws upon political and behavioral theories of the firm. According to this model, what really determines IT impacts is who controls computing and has the ability to use it to achieve self-interests. The impetus for innovation is the perception on the part of members of the dominant coalition controlling computing decisions that there is an opportunity to promote their interests and enhance their position (Danziger, Dutton, Kling, and Kraemer, 1982; Kraemer and Dutton, 1979). Managerial actionalism thus draws attention to individuals, their interactions, social constructions, and autonomy (Astley and Van de Ven, 1983). Consequently, research efforts using this model of change are directed away from the technology per se, toward managerial decision processes and the concepts of politics and dominance in organizations.

The managerial actionalism perspective conceptualizes organizations as a system of individuals with unequal power, authority, and influence, and with divergent interests. An organization is a set of loosely coupled units from which joint action rests on negotiation (Weick, 1976). In its pure form, the managerial actionalism model assumes that organizations are constructed, sustained, and continuously changed by actors' definitions of the situation and by their actions (Astley and Van de Ven, 1983). This model of change also assumes that choice

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is available in the design of organizational structures, which are therefore fashioned in accordance more with political considerations (bargaining, personal needs, self-interested behavior) than with technical criteria. The design of structures is assumed to be largely under the control of organization members. Managers are seen as proactive, as the energizing force that shapes organizational structures (Astley and Van de Ven, 1983). Middle managers are seen not only as information processors, but also as political actors who use and manipulate information to promote their personal interests and assure their growth.[2]

As the arrows in Figure 2.1 illustrate, managerial actionalism also assumes that IT does not determine organization structures in any significant manner. (This is represented by the absence of an arrow from IT to organization.) Instead, it is the managerial action that mostly determines organization structure. IT is conceptualized as a malleable tool that, of itself, does not shape the structure of organizations one way or the other. It is an adjunct to managerial decision that is mostly fashioned in accordance with the structure of dominance over computing decisions. (This is represented by a feedback arrow in Figure 2.1.)

The fundamental arguments based on the managerial actionalism models for the impact of IT on the number of middle managers can be summed up as follows. Decreases in the number of middle managers occur in organizations where it is top managers who control computing because they have a propensity to substitute IT for middle managers. Increases in the number of middle managers occur in organizations where it is middle managers who control

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computing because they promote their personal interests of growth and of greater authority through it.

Here again, although scholars have long recognized the frequent inadequacy of managerial actionalism in its "pure" form, they have often given strong preponderance to it. For example, Robey (1981) explains his findings of the overall lack of IT's consistent impact by the fact that "changes in structure appear a consistent companion to either rational management objectives, political strategies, or both" (p. 686). The basic argument he proposes is that IT is a malleable tool that has no apparent necessary relation to organization structure and that does not limit structural choices. It is who controls computing and can achieve personal goals through it that determines what structural changes arise from IT intervention. This is similar to the reinforcement politics perspective proposed by Kraemer and Dutton (1979). Blau et al. (1976) also favor a managerial actionalism oriented approach. They explain findings of increased decentralization of decision authority and increased number of hierarchical levels according to where computing is located. On-site computers, when division managers control computing, foster decentralization of decision authority. Off-site computers, when headquarter managers control computing, foster centralization of decision authority. Their analysis relies heavily on the managerial actionalism model and gives little importance to what exactly IT capabilities are.

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Conclusion

It is clear from the above discussion of models of change that there are two fundamental factors determining the impact of IT on the number of middle managers. The first is what roles middle managers play in organizations and how structured, standardized, and routine these roles are (the technological determinism model). The second factor is who controls the choice and usage of computing and has the ability to achieve personal interests through it (the managerial actionalism model).

The next chapter presents the framework we developed based on an interactionist model of change. The approach favored in this study incorporates the technological determinism and the managerial actionalism models. Next, the concepts are defined, and the hypotheses generated from the framework are discussed.

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Endnotes

1. IT and the concentration of decision authority are closely related phenomena. Centralized organizations rely on fewer middle managers than decentralized organizations. Therefore, centralizing authority and decreasing the number of middle managers are likely to be associated. However, the relationship between centralization and decentralization of authority and reduction and proliferation of middle managers is not perfect. Centralization might occur from the operation level to the middle-level, in which case it might not be accompanied by a reduction of middle managers, but most probably by their proliferation. Similarly, decentralization does not necessarily mean more middle managers. Fewer middle managers may have more decision authority. Also the centralization of authority is not a zero-sum game. One does not have to lose authority for another to gain some. There can be greater centralization at the top of the hierarchy without corresponding decrease of authority at lower levels. Hence, although centralizing decision authority is likely to be associated with reduction of middle managers and decentralization with their proliferation, the relationship is not perfect. Only those studies of this issue that provide information specific enough to allow us to determine how their findings relate to the change in occupational profile of middle managers are included in the present study.

2. This utilitarian behavior has been stressed in sociology (Olson, 1966), economics (Alchian and Demsetz, 1972; Arrow, 1963-64; Coase, 1937; Fama, 1980; Jensen and Mecklin, 1976; Pratt and Zeckhauser, 1985), psychology and organization behavior (Galbraith and Cummings, 1967; Mintzberg, 1983; Porter and Lawler, 1968; Vroom, 1964), as well as in MIS (Danziger et al., 1982; Kraemer and Dutton, 1979).

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Chapter III

Conceptual Framework, Concepts, and Hypotheses

This chapter discusses the conceptual framework we developed based on the technological determinism and managerial actionalism models of change. It also defines the concepts and the measures used in this study and discusses the hypotheses that will be tested.

An Interactionist Framework for the Analysis of the IT Impact on the Middle Management Workforce

The technological determinism and managerial actionalism models of change presented in Chapter 2 are two opposite ends of the organization change continuum (Figure 2.1). The two models provide different perspectives on how and why IT affects the number of middle managers. In fact, it is the contention of this study that the two approaches are complementary and that an interactionist model of change that draws on both technological determinism and managerial actionalism models is best. As discussed in Chapter 1, focusing attention on technology or on managerial action alone is not sufficient to fully understand the IT impact. The relationship between technological changes and societal and organizational changes results from both technology and managerial actions. Technology fosters changes in organizations by providing new

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capabilities that can be exploited to achieve goals more efficiently. Managerial actions materialize the technological capabilities by integrating interrelated technologies. Therefore, one can only fully understand how and why IT affects the occupational profile of middle managers by taking into account the interaction between the technological determinism and the managerial actionalism models of change. The interactionist framework is presented in Table 3.1 and further discussed next.

Table 3.1

A Framework for the Analysis of the IT Impact on Middle Managers'

		Structure of organizational decision (technological determinism): High centralization	Structure of organizational decision (technological determinism): Low centralization
Structure of computing decision (managerial actionalism)	High centralization	Extensive centralization 1	Partial centralization 2
Structure of computing decision (managerial actionalism)	Low centralization	Partial decentralization 3	Extensive decentralization 4

MM = Middle managers

Structure of Computing Decision

The first dimension of the framework is the structure of computing decision making authority. Recall from Chapter 2 that the managerial actionalism model explains the impact of IT on middle managers according to

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who controls computing. IT decreases the number of middle managers in centralized organizations and increases their number in decentralized organizations.[2]

In *centralized organizations*, top managers control major computing decisions. The interests of top managers converge most closely with the interests of the overall organization. They are among the most committed to the organization. They personify the organization and they embody organizational purpose (Long, 1960; Mintzberg, 1983; Selznick, 1957).[3] It is in the overall interest of the organization to function efficiently and effectively, and it is the manager's job to achieve theses goals. Efficiency is usually increased by substituting capital for labor.[4] Hence, managers will substitute IT for middle managers for whatever functions IT performs best. Effectiveness is usually increased by the ability to control the premises of decisions of lower level subordinates.

Moreover, middle managers are a source of uncertainty for top managers. Middle managers control information, and they may consciously or unconsciously alter the information they transmit. This creates uncertainty for top managers because of the increased probability that top managers will receive altered information[5] and because the interests of the two groups are not totally compatible. Top managers reduce this uncertainty by using IT to gain greater control over information through the elimination of middle managers.

In addition, by replacing middle management with IT, top managers appropriate decision authority. By eliminating middle managers, top managers

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enlarge the hierarchical gap between them and the next lower level managers (operations level managers) and centralize decision authority. Decision authority is the character of a communication which generates acceptance by a member of governing actions (Barnard, 1938). Hence, authority is granted to higher level position holders by lower level members who accept communications from their superiors because they perceive the communications as important and for the good of the organization. Operations level managers are more likely to perceive communications from top managers as being important and for the good of the organization than similar communications filtered through a narrower hierarchical gap. Consequently, whether or not top managers actually appropriate the surplus of authority created by the reduction in middle managers, lower level managers will act as if top managers had appropriated the authority because of the large hierarchical gap through which communications are channelled.

In *organizations with a decentralized structure of computing decision authority*, middle managers control computing. Their interests are reflected in two forces: on the one hand, an identification with top managers and their goals of growth, greater efficiency, centralization of decision authority, and survival of the organization; and on the other hand, an attempt to further personal ambitions (autonomy, achievement, greater decision authority and power) through the growth of their unit and/or the circumvention of control systems (Mintzberg, 1983; Stewart, 1987). Middle managers will favor the attainment of personal objectives through computing because their prestige, status, power, and salary basically depends on the size of the unit they manage.[6] Also, furthering

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"organizational" interests could result in their elimination (as it does in centralized organizations). Consequently, in organizations with decentralized structure of computing authority, IT is likely to increase the number of middle managers.

Research shows that whoever controls computing decisions is able to reinforce systematically their power and authority through the choice and usage of IT, and thereby, to fundamentally shape the organizational impacts of IT (Boddy and Buchanan, 1984; Danziger et al., 1982; Kraemer and Dutton, 1979; Robey, 1981). However, as discussed in Chapters 1 and 2, the IT impact on middle managers also depends on the roles middle managers play. Their roles may facilitate or counter the basic managerial effort to use IT to change the middle management workforce.

Structure of Organizational Decision

The second dimension of our framework is the structure of organizational decision making authority, which excludes computing authority. Recall that the technological determinism explanation of the impact of IT on the number of middle managers is that IT decreases the number of middle managers in centralized organizations and increases their number in decentralized organizations. The roles of middle managers are more easily amenable to computerization in centralized organizations than in decentralized organizations. As in the study of Pugh, Hickson, Hinings, and Turner (1968), the structure of

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decision making authority is used in the present study to depict the role profile of managers in organizations.

Managers perform ten basic roles: (a) interpersonal roles (figurehead, leader, liaison), (b) decisional roles (entrepreneur, disturbance handler, resources allocator, negotiator), and (c) informational roles (monitor, disseminator, spokesman).[7] Managers at the middle level are most concerned with the decisional and informational roles and not as much with the interpersonal roles (Chapple and Sayles, 1961; Kurke and Aldrich, 1983; Mintzberg, 1973). These authors have found that the roles of managers are significantly affected by contingent factors related to the organization (e.g. the size of the organization, the industry). It is the premise of this dissertation that the role profile of middle managers is also affected by the structure of decision authority. In centralized organizations, authority is concentrated at the top of the hierarchy. Consequently, middle managers perform fewer decisional roles and proportionally more informational roles. (The importance of the interpersonal roles does not vary across organizations.) Also, several decisional roles of middle managers in centralized organizations are routine, standardized, and structured. Conversely, in decentralized organizations, a greater portion of decision authority is distributed at the middle management level. Consequently, middle managers perform more decisional roles and proportionally fewer informational roles. Also, a greater proportion of their decisions are unstructured and unstandardized.

Therefore, the structure of organizational decision authority sets the range of the IT impact that can occur. Situations where the roles of middle managers

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are mostly structured and informational limit the use of IT to increase the number of middle managers and facilitate its use to decrease middle management. On the other hand, situations where the roles of middle managers are mostly unstructured and decisional facilitate the use of IT to increase the number of middle managers, but limit its use to decrease middle management.

The Four Contingent Situations

The framework presented in Table 3.1 results from the interaction of the structure of organizational decision and the structure of computing decision and contains four situations. Two situations are "extensive;" that is, both structures of decision converge and reinforce each other's influence on the IT impact. This is where the most pronounced and significant IT impact will occur. And two situations are "partial;" that is, the two structures of decision counter each other's moderating effects on the IT impact.

Extensive centralization. In extensively centralized organizations (cell 1), the two structures of authority are centralized. Top managers control computing decisions and the main roles of middle managers are informational and structured decisional. Consequently, top managers will be able to initiate the use of IT so that the greater part of middle managers' jobs will be taken over by IT and middle management will be consolidated and reduced.

Extensive decentralization. Conversely, in extensively decentralized organizations (cell 4), the two structures of authority are decentralized. Middle managers control computing, and their main roles are unstructured decisional.

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Consequently, they are able to choose and use the IT that will take over only a limited portion of middle managers' jobs (some of the more routine decisions and some informational roles), which will permit middle managers to give greater attention to the unstructured decisions and increase their number and their importance to the organization.

The impact of IT is much less pronounced in the two partial situations than in the extensive situations because the two structures of authority counter each other's moderating effect. However, because the structure of computing authority has been found to be predominant, small IT impacts are still expected.

Partial centralization. In the partial centralization situation (cell 2), computing authority is centralized, but the structure of organizational decision is decentralized. The roles of middle managers are not easily amenable to computerization, but top managers control computing and try to reduce middle management by capitalizing on the portion of the roles that can be automated. Organizations with a partial centralization structure will experience a small decrease in the number of middle managers. This may be a proportionate decrease rather than an absolute one. That is, middle managers are kept stable while the rest of the organization grows.

Partial decentralization. In contrast, in the partial decentralization situation (cell 3), middle managers control computing, but their roles are easily amenable to computerization. To protect their interests, middle managers choose and use the IT that reinforces and creates greater demands for their unstructured roles. This increases their importance and makes them more essential to the

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organization. However, because their unstructured roles occupy only a small fraction of their functions, the increase will be small.

The conceptual framework presented in Table 3.1 provides the basis for deriving research hypotheses for the study. Before discussing the hypotheses, however, it is necessary to define the concepts and the variables used for measuring the concepts.

Concepts and Measures

This research centers on four key concepts: (a) information technology, (b) middle management, (c) structure of organizational decision making, and (d) structure of computing decision making. Each is discussed next.

Information Technology

Concept. Information technology can be conceptualized in a variety of ways:

(a) in terms of the technology itself, including considerations such as power, capacity, sophistication (George, 1986; Kraemer et al., 1981; Lehman, 1985),

(b) in terms of the extent of application of the technology within the organization, including, for example, the number of computer applications in operation (Blau et al., 1976; Klatzky, 1970; Kraemer et al. 1981; Pfeffer and Leblebici, 1970), and

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(c) in terms of the actual use of the technology by individuals within the organization (Carter, 1984; Gremillion, 1984).

While each is an appropriate measure, it is the extent of automation that is most directly relevant to this analysis. Computer power or technological sophistication might be great but narrowly applied, and consequently its impact on middle management would be light. Similarly, computer use by individuals might be concentrated in particular roles, functions, or levels in the hierarchy, and therefore high levels of use again might not be related to middle management impacts.

The extent of automation is an appropriate concept because it measures the degree to which automation has penetrated the organization broadly, across functions horizontally and across roles or levels of the organization hierarchy vertically. And the more pervasive the technology's application, the greater the likelihood that its impact will be sufficient to affect middle management. For example, the greater the penetration the greater the likelihood that the computing package will allow top managers to bypass middle management and to operate without them.

Measure. The concept of the extent of automation has been operationalized in a number of ways in the past:

(a) according to the number of hardware devices and software applications (Klatzky, 1970; Whisler, 1970),

(b) according to the number of functions performed on computers (Blau et al, 1976; Whisler, 1970),

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(c) according to the number of employees tending to use computers (Pfeffer and Leblebici, 1977),

(d) according to the number of minutes in-house and off-site computers are used per day (Blau et al., 1976), and

(e) according to the monthly cost and yearly budget for data processing (Pfeffer and Leblebici, 1977).

There are two problems with using these measures. First, they do not specifically focus on the information systems that are most likely to affect middle managers, but are instead measures of the extent of computerization in general. These measures do not fully account for the fact that different information systems affect organizations differently. The second problem is that these measures are heavily dependent on organization size. Klatzky (1970) found a correlation of .821 between and the number of computers and terminals and organization size, and Pinsonneault (1988) shows a correlation of .710 between the DP budget and organization size, and of .520 between the number of hardware artifacts and organization size. This is problematic in the present study because the dependent variable (the number of middle managers) is also heavily dependent on the size of the organization. Using the above measures as a surrogate for the extent of automation might cloud our analysis with a spurious effect of size.

The foregoing problems are alleviated in two ways in the present study. First, field work and personal knowledge of different information systems are used to develop indexes that comprise only the computer applications that are

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most likely to affect the number of middle managers. Examples of such information systems are office automation, inventory, and dispatching systems. The second way the foregoing problems are alleviated is that the measure of the extent of automation comprises only basic information systems that do not require very extensive resources and can therefore be accessible to most organizations of our sample of cities of 50,000 population or more. Also, as will be seen later in this chapter, each index is divided by the total number of applications in operation to obtain ratio measures, which are less likely to be correlated to size. Therefore, it is expected that differences on those indexes do not reflect differences in organization size but rather depict different intensities of computing. These indexes will be tested against other size-related measures to determine if they are in fact better than the measures used in previous studies.

Four indexes are used to measure the extent of automation. Three indexes (control, coordination, and efficiency applications) measure how automated different applications are. The fourth index (access) measures the accessibility of the different types of applications. Each index is presented and illustrated through an example in Table 3.2 and discussed next.

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Table 3.2
Measure of the Extent of Automation

Control IS:	Information systems that support government activities which allocate resources, monitor, limit, or restrict actions of organization members and/or monitor the performance. They are vertical information systems that cross hierarchical levels and that permit higher level managers to monitor lower level activities and disseminate information and decisions about policies, procedures, rules, and norms.
	Examples: Budget control, maintenance and inspection record and scheduling, vehicle and manpower resource allocation, inventory management, licenses enforcement, and treasury and collection systems.
	Rationale: Budget control systems are designed and used explicitly for limiting and rationing the expenditures of government departments or agencies.
	Measure: Ratio of the number of control oriented computerized applications in operation to the total number of computerized applications in operation in a city.
Coordination IS:	Information systems that support the communication of information and decisions between managers of a similar hierarchical level. They are horizontal information systems crossing different units, departments, or divisions.
	Example: Geographical information systems.
	Rationale: A typical usage of a GIS is the coordination of public works' major streets improvements with other jobs (e.g. gas line rerouting).
	Measure: Ratio of the number of coordination oriented computerized applications in operation to the total number of computerized applications in operation in a city.
Efficiency IS:	Information systems that can affect the occupational profile of middle managers by increasing their efficiency and productivity.
	Example: Electronic mail, calendaring, word processing, statistical and modeling packages.
	Rationale: Electronic mail and calendaring facilitate mail writing, sending, receiving, and scheduling of diverse events.
	Measure: Ratio of the number of efficiency oriented computerized applications in operation to the total number of computerized applications in operation in the city.
Access to the IS:	How widespread the access to these applications is. It is a measure of how many people can access the different applications.
	Measure: Ratio of the number of terminals and personal computers attached to a mainframe or like computer on which the control, coordination, and efficiency applications are operating to the total number of employees in a city.

The *control oriented systems* allocate resources, and monitor, limit, and restrict actions of organization members and/or the consequences of those actions (the performance). Control systems are vertical information systems that permit higher level managers to monitor lower level activities (upward information flow) and to disseminate information about policies, procedures, and rules to lower level managers to control the premises of the decisions they make (downward information flow). Control information systems cross the levels of the hierarchy.

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They consist of six types of information systems (see Appendix A for a detail list of the information systems):

(a) maintenance and inspection records and scheduling (vehicles, buildings and streets),

(b) vehicle and manpower resource allocation,

(c) inventory management and purchasing,

(d) license enforcement systems,

(e) payroll and accounting, and

(f) treasury and collection systems.

These control systems limit or restrict action, or monitor performance. For example, maintenance and inspection records and scheduling systems are used by managers to control and monitor maintenance and operating costs incurred by vehicle fleets and also to schedule inspection.

Considering inventory management and purchasing systems as control oriented information systems is peculiar to service organizations. When the two systems are linked together to form an automatic inventory reordering system, their main impacts on the number of middle managers is likely to be of coordination nature. However, this is likely to occur in manufacturers, distributors, or retailers for whom inventory management is crucial. A good example is the Analytic Systems Automatic Purchasing (ASAP) of the Baxter Corporation (which owns the American Hospital Supply Corporation). In local governments, the nature of inventory management and purchasing systems is to permit managers to keep track of what the organization owns or must manage

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(buildings, streets, vehicles), and to standardize procedures for acquiring supplies to maintain the buildings, streets, and vehicles (through lists of accepted suppliers, price range, and makes and models of things to buy). The impact the inventory management and purchasing systems on the number of middle managers is likely to be from their control nature in city government.

The distinctive characteristic of *coordination oriented systems* is that they are used to link different units by communicating information and decisions between interdependent managers of similar organizational levels. They are horizontal information systems that connect managers across different units, divisions, departments, or even branches of the organization. The coordination applications are not used to monitor, supervise, or restrict actions of organization members. In local governments, the geographic information systems[8] are the coordination oriented systems that are most likely to affect the number of middle managers. (See Appendix A for a list of the individual information systems.) Geographic information systems permit managers of different parts of the organization to coordinate their efforts. For example, when a street needs to be repaved, managers of the public works department can find out if other improvements need to be made by another department and coordinate their work most efficiently.

Efficiency information systems affect the number of middle managers by increasing their efficiency and productivity. They permit fewer middle managers to perform the same amount of work prior to computerization, or the same number of middle level managers to perform more work. The office automation

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systems are the systems that are most likely to affect middle managers by increasing their efficiency. (See Appendix A for a list of the individual systems.) Communication and document preparation systems (electronic mail, calendaring, and word processing) facilitate the writing, editing, sending, and receiving of mail and documents. Statistical analysis and modeling systems support the making of decisions.

Two remarks need to be made regarding control, coordination, and efficiency applications. First, several information systems contain some coordination, control, and efficiency components. However, their major impact on the number of middle managers results from one of the three components and the information systems are classified according to which component has the most important effect. For example, office automation systems have both a coordination and an efficiency component. The coordination component is the capacity they provide to managers to communicate in a synchronous and asynchronous manner. However, this component is likely to affect the mail personnel rather than middle managers per se. It takes over the communication links and the physical transportation of memos and letters between managers traditionally done through the mail system, but it does not affect the managers' coordination activities per se. On the other hand, the efficiency component directly affects middle managers because it makes them more productive. It facilitates the writing and editing of documents and mail, and it supports the making of decisions.

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The second remark is that the more complex applications (e.g. simulation models, investment/portfolio management, fiscal impact/cost revenue analysis applications) are not included in the three indexes. They only comprise the relatively basic information systems that do not require extensive resources or expertise and that are therefore accessible to most larger city governments. This makes the measure of the extent of automation less related to organization size.

The fourth index of the extent of automation is the *accessibility* of the foregoing applications to the organization members. That is, how easily one can access the applications. A simple measure of access is the number of terminals and personal computers attached to the computer in which the applications reside. The extent of automation is measured by asking the DP manager of each installation to indicate which information systems of a comprehensive inventory are operational currently and how many access points there are. To obtain the installation level indexes of the extent of automation, the responses for each of the four indexes are summed. Then an organization level measure is obtained by summing the installation level indexes for all installations in the organization. As will be seen in Chapter 4, to obtain a more meaningful and valid measure, the applications indexes are divided by the total number of applications in operation in the city, and the access index is divided by the total number of employees in the city.

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Middle Management

Concept. The question that needs to be addressed with regard to the concept of middle management is who they are and how to define and differentiate them from other managers meaningfully. To address this question it is useful to look at how scholars conceptualize "middle management" in organization theory. Middle management is conceptualized as the link between top management and operations management. Chandler (1977) argues that middle managers emerged to mediate between operations level managers and top managers when organizations became larger and more complex (new technology, different products, vertical and horizontal integration, geographical dispersion).

Thompson (1967) also suggests that the main function of middle managers is to mediate between top and operation level managers. Top managers perform the open-system function of co-aligning the organization with the environment, and the operations level managers perform the closed-system function of striving for the greatest possible operational efficiency. Consequently, according to Thompson, the main focus of middle managers is to link the two groups by monitoring operations and disseminating the information upward to top managers, and by operationalizing, detailing, and disseminating information about objectives, procedures, and standards downward from top managers to operations managers.

Katz and Kahn (1966) provide a similiar conceptualization when they argue that top, middle, and operations managers have three different roles in the organization. They contend that only the top echelons of line and staff officers

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are really in a position to introduce changes in structure. The piecing out of structure is found most often in the intermediate levels of the organization. And the lowest supervisory level has open to it mainly the exercise of leadership by the skillful use of existing structure.

In conclusion, these conceptualizations revolve around one key element. In essence, middle managers operationalize, detail, further define, and disseminate information about objectives, policies, and structural changes formulated at the top of the hierarchy. Middle managers also monitor and aggregate detail information from operations, without directly managing them or executing policies and procedures, in a form useful to top managers. Consequently, middle managers are neither at the top of the hierarchy--where policies and procedures are determined--nor directly supervising operations--where the policies and procedures are executed. They are in the middle, linking the two groups by interpreting and operationalizing policies and procedures.

Following the above discussion, the lower boundary of middle management is set above first level supervisors because managers from this level down directly supervise operations and are responsible for executing policies and procedures. The upper boundary is set below the department head because managers from this level up are actually responsible for designing policies and procedures and for introducing changes in the organization. Consequently, middle managers are the staff and line managers above first-level supervisors but below department heads.

It is important to note that the concept of organization hierarchy is continuous. That is, middle managers do not form a well defined homogeneous

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group that can easily be differentiated from top managers and operations level managers. The cut off points between managers of different levels of the hierarchy are admittedly subjective. The differences in emphasis on certain roles between managers with a small hierarchical gap is less pronounced than differences in roles between managers with a large hierarchical gap. However, it is felt that the above classification captures the essence of middle management.

Measure. The number of middle managers in organizations is measured by asking the city manager or the assistant city manager to define the number of employees at four levels in the organization:

(a) top management,

(b) department head,

(c) division head, and

(d) lower level managers (below division head and above 1st level supervisor).

The middle managers are the division head (c) and the lower level manager above first level supervisor (d).

Structure of Organizational Decision Making Authority

Concept. The definitions of the structure of decision authority proposed in organization theory are similar and can be summed up as the distribution of authority to make decisions affecting the organization. This definition contains two key elements: "distribution" and "decisions affecting the organization." The *distribution* element refers to the degree of concentration of authority, or, put

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another way, at what minimum level of the hierarchy significant decisions can be made. *Decisions affecting the organization* is the second key element of the definition. Centralization and decentralization result from the distribution of decision authority to make significant decisions, or decisions that affect the organization. Widespread distribution of authority to make routine, structured, and standardized decisions is not decentralization because these decisions are merely the implementation of rules and standards. The decisions that affect organizations in this case are those made higher in the hierarchy when establishing rules and standards. Rather, decentralization is the distribution of authority for making non-routine and non-structured decisions requiring some degree of autonomy. For example, the delegation of authority to approve requests for the acquisition of equipment is not decentralization if it is also accompanied by precise standards that specify that all requisitions under a certain amount of money be approved. On the other hand, the delegation of the same decision authority accompanied by standards and rules specifying that requisitions be approved when they are congruent with the department and organization goals and when they respect budgetary constraints constitutes decentralization. It leaves lower level managers autonomy and power to decide whether or not to approve the requests. The concept of structure of organizational decision is used to capture the overall concentration of authority across functions and for different types of decisions.

Measure. There are two main schools of thought on how to measure the structure of decision authority. In the first approach, investigators rely on

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organization charts, documents, and interviews with a few key spokesmen of the organization, usually top managers. This approach generally taps the formal or designed structure which represents the organization's long-run response in adapting to environmental and technological changes (Blau, 1967; Child, 1972; Pugh et al., 1968; Reimann, 1973; Samuel and Mannheim, 1970). In the second approach, investigators measure the structure of decision authority by aggregating responses from a sample of organization members at different levels of the hierarchy. This approach taps the emergent structure of decision making authority, or the actual behavior of organization members. This approach gets at the mechanisms by which organizations adapt to short-term variations in the environment.

The main difference between the two approaches is whether they focus on the designed and long-term structure or on the emergent and short-term structure. The long-term oriented approach is more appropriate for the present study. Change in the occupational profile of middle managers is a relatively long process resulting from changes in the roles of middle managers, which by itself is a lengthy process. Also, there is a five year lag structure between IT usage and organization change (Brynjolfsson et al., 1988). Therefore, although the second approach might provide some interesting insights, it is more appropriate to use the approach that measures the long-run response of the organization in adapting to technological change.

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There are several ways to measure the designed structure of decision making authority:

(a) chief executive span of control, worker/supervisor ratio, and the number of direct supervisors (Pennings, 1973; Pugh et al., 1968),

(b) the number of subordinates for each position in the hierarchy (Ford, 1979; Sathe, 1978), and

(c) the average number of hierarchical levels (Ford, 1979).

However, most of these measures reflect aspects of the configuration of the hierarchy rather than the distribution of authority and power in the organization. The measure of the Aston group most directly assesses the dispersion of authority in the organization (Inkson, Pugh, and Hickson, 1970; Pugh et al., 1968). It measures the structure of authority by determining the lowest level at which twenty-three different decisions can be made. It covers managing personnel, budget allocation and control, and equipment and material acquisition and control.

The major criticism that has been raised regarding the Aston scale is that it is strongly tied to the specific empirical context of the fifty-two organizations used to develop it (Aldrich, 1972). This criticism has been addressed since Aldrich raised it and has proven to be easy to accommodate by adapting the scale to the context of the study (Hickson, Hinigs, McMilliam, and Schwitter, 1974; Hsu, Marsch, and Mannari, 1983). The present study alleviates the problem Aldrich raises by modifying slightly the wording of some items of the scale so they better correspond to the organizational reality of top managers in local

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governments. This scale has been widely used in England, the United States, and Canada, as well as in a previous URBIS study, and has proven to be very reliable.

Structure of Computing Decision Making Authority

Concept. The structure of computing decision refers to the distribution of authority to make decisions regarding computing that affect the organization. This concept is similar in its logic and key components to the structure of organizational decision, but it refers strictly to computing decisions. Decentralization occurs when authority to make significant decisions about computing is spread throughout the organization.

As discussed in the previous section, we are interested in measuring whether authority is concentrated at the top of the hierarchy or whether it is distributed at lower levels.

Measure. As with the structure of organizational authority, two approaches can be used to measure the structure of computing decision. While each approach is valid, it is the designed structure that is more relevant and applicable to the present analysis. Acquisition, design, and usage of computerized information systems require important sums of money that are most often processed and authorized through the formal structure. Also, even for small computerized systems, managers keep track of and control the evolution of computing. They establish formal standards and rules for the acquisition and use of these systems. Therefore, it seems that the formal or designed structure of authority best describes who controls computing. Also, by measuring the

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designed structure, we are congruent with the way we measure the structure of organizational authority and we alleviate potential measurement problems (Sathe, 1978; Walton, 1981).

There exists no established way to measure the structure of computing authority. Some have adapted the Aston scale (Olson and Chervany, 1980), while others have developed their own measures, which, for the most part, are not robust and well tested. Three different indexes are used in the present study. The first index measures the *number of computer installations* in the organization. An installation is defined in the URBIS study as a set of hardware (mainframe or minicomputer systems), with staff directly responsible for operating the system, installing and maintaining applications, and operating more or less independently of other computer installations. The more installations an organization has, the more dispersed and decentralized is its computing authority.

The second index measures who in the organization is *most influential in making decisions* regarding computing. This index covers (a) deciding on new applications, (b) approving budget for major and minor computer purchases, (c) evaluating the services of an installation, and (d) deciding on organizational arrangements (e.g. creation of an information center). Respondents indicate which following individual or group is most influential in each foregoing decision:

(a) data processing manager,

(b) department head over DP,

(c) user department heads,

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(d) chief administrative officer, or

(e) local legislative body.

There is one index of influence for each installation, which is summed for all installations to obtain an organization-wide measure.

The third index assesses which individuals or groups are *involved in making each computing decision* described above. This index is also measured at the installation level and then aggregated at the organization level.

Hypotheses

We are now ready to specify the relationships we expect to find between the concepts described above. Recall that we are interested in two sets of relationships. The first is the relationship between the extent of automation and the middle management workforce. The second is the effect the structure of organizational decision and the structure of computing decision have on the IT-middle managers relationship.

The literature review indicates that previous empirical findings are not consistent and could lead to any of two predictions: IT decreases the number of middle managers or IT increases the number of middle managers. However, the framework presented in Table 3.1 leads us to make a contingency-based prediction. The framework argues that the effect of IT on the middle management workforce varies with the concentration of decision authority. The essence of the framework is captured by the following four hypotheses.

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Hypothesis 1:

The more centralized the decision authority, the more the extent of automation will reduce the ratio of middle managers.

Recall from the framework of Table 3.1 that the concentration of decision authority is determined by the concentration of computing authority and the concentration of organizational authority. Therefore, if hypothesis 1 is true, the following propositions are expected:

Proposition a:

When the structure of computing authority is centralized and the structure of organizational authority is centralized (extensive centralization), the extent of automation decreases the middle management workforce.

Proposition b:

When the structure of computing authority is decentralized and the structure of organizational authority is decentralized (extensive decentralization), the extent of automation increases the middle management workforce.

We also expect that when the two structures of decision authority are opposite (partial situations), they cancel each other's moderating effect and the impact of IT is null. However, as discussed earlier and as research shows, the structure of computing decision authority fundamentally shapes the IT impact (Boddy and Buchanan, 1984; Danziger et al., 1982; Kraemer and Dutton, 1979; Robey, 1981). The structure of organizational authority facilitates or counters the moderating effect of the structure of computing authority.

Proposition c:

When the structure of computing authority is centralized and the structure of organizational authority is decentralized (partial centralization), the extent of automation decreases the middle management workforce.

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Proposition d:

When the structure of computing authority is decentralized and the structure of organizational authority is centralized (partial decentralization), the extent of automation increases the middle management workforce.

Recall that extensive centralization and the extensive decentralization are the two opposite ends of the concentration of authority continuum and that partial centralization and partial decentralization are hybrid situations or intermediate on that continuum. Therefore,

Proposition e:

The impact of the extent of automation is more pronounced in the extensive situations than in the partial situations.

Hypothesis 2a:

Top managers use the control and the efficiency applications to reduce the middle management workforce.

Hypothesis 2b:

Middle managers use the control and the coordination applications to increase the middle management workforce.

Recall from the discussion of the concepts that the extent of automation is measured through three types of applications: control, coordination, and efficiency applications. Hypotheses 2a and 2b contend that top managers and middle managers, when they are in a position to influence computing decisions, will use different combinations of applications to achieve their goals.

Top managers' effort to reduce the number of middle managers is an attempt to reduce their uncertainty and increase their authority. The control oriented systems serve these efforts best. They permit top managers to bypass the formal hierarchy and have direct access to more information, appropriating

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decisions previously made by middle managers. Efficiency systems are useful to top managers in their efforts to decrease middle managers because in centralized organizations the number of middle managers is relatively small. Consequently, there may not be many slack resources to cut. The efficiency oriented systems permit top managers to bring the middle management workforce to its minimum by increasing middle managers' efficiency and productivity.

Middle managers will use control and coordination information systems to achieve their goals. As for top managers, middle managers are be able to choose and use the control systems that permit them to access more information and to appropriate decisions previously made by lower level managers. Middle managers are also likely to use coordination systems because they link different parts of the organization and provide a wealth of information on other units, making middle managers the information gatekeepers of the organization. Control and the coordination systems are the applications that are most likely to increase the number of middle managers and their importance to the organization, and middle managers will use them for that purpose.

Hypothesis 3

> The increase in the middle management workforce in decentralized organizations is more pronounced than the decrease in the middle management workforce in centralized organizations.

This hypothesis is based on the premise that highly centralized organizations have a minimum number of middle managers to adequately perform the necessary functions required at this level of the hierarchy (e.g. to define, help develop, and carry out automation and other programs in their respective areas).

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Consequently, there are not many "slack" resources that can be cut off at the middle level of centralized organizations.

In addition, the focus of this study is on local governments, which, as other governmental institutions, are often more reluctant to lay off employees than firms of the private sector. Displacement and retraining are usually chosen as an alternative to layoffs in public sector organizations.

The next chapter discusses the research methodology used to test the five hypotheses. It also discusses the construction of the indexes and describes the procedures used to conduct the analysis.

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Endnotes

1. The structure of decision authority is multidimensional. Decision authority can be unequally centralized across different functions of an organization. For example, decision authority might be more centralized in production than in MIS. The structure of computing decision authority is likely to be correlated with the organization structure of decision authority. In other words, computing decision authority is likely to be centralized in centralized organizations and decentralized in decentralized organizations. However, the two dimensions are not perfectly correlated and, therefore, there are organizations in each of the four cells of Table 3.1.

2. Research shows that major computing decisions are controlled by top managers or middle managers. When they are made at lower levels, they often need to be approved by higher-level managers, or to comply with standards established higher in the hierarchy (Hoos, 1960; Whisler, 1970). There are three reasons for this control by top and middle managers. First, IT is a critical resource in most organizations. It is a functional necessity as well as a strategic one without which most organizations can no longer compete and survive. Second, very large budgets are allocated to IT (annual DP budgets of several millions of dollars are common). Third, the control of IT is one of the main intra- and inter-organization communication devices and the source of important power and authority (Pettigrew, 1973; Pfeffer, 1978).

3. England (1967) found that over 90% of 1072 top managers surveyed rank "my company" as being highly important, whereas only 52% of the owners rank it as such. Also, Brager (1969) found that organizational commitment varies with hierarchical levels: almost half of top managers are in the top third of the commitment scale, compared with 38% for supervisory and consultant, and only 26% for operations employees (Mintzberg, 1983).

4. Top managers have a propensity to substitute capital for labor (Braverman, 1974). The case of IT reducing middle management is seen as the continuation of the industrial revolution. Steam engines replaced people, robots are becoming increasingly predominant in assembly lines, and computers are replacing managers. This is often posited by students of the effects of technology on unemployment (Chern, 1980; Guiliano, 1982; Hines and Searle; 1979; Jenkins and Sherman, 1979; Sleigh, Broatwright, Irwin, and Stanyan, 1979).

5. Messages transmitted from one person to another are rapidly altered, often after only a couple of transmissions (Campbell, 1958; Whisler, 1975). Berger and Luckman (1967) argued that reality is subjectively and differently perceived by individuals. Perceived reality is never objective, but is instead an individual's constructed representation of it.

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6. An excellent illustration of such self-interested behavior of middle managers is Dalton's study of managerial behavior (1959), in which he shows how middle managers used deception to protect themselves from the head office.

7. The *figurehead* role is the participation of managers in social events as representatives of their unit. The *leader* role the hiring, training, promotion, remuneration, dismissal, and motivation of subordinates. It is the role of integrating individuals' needs with organizational goals. The *liaison* role is assumed when managers make contact outside the vertical chain of command. The *entrepreneur* role is played by managers seeking to improve their unit by adapting to the environment. The *disturbance handler* role in management is response to outside pressure, especially when it was ignored too long and now requires management action. The *resources allocator* role is deciding who in the unit will get what resources. The *negotiator* role is assumed when managers trade resources with other units or with outside agencies. The *monitor role* is the collection of information for the organization. The *disseminator* role is the transmission of information within the organization. The *spokesman* role is the transmission of information to outsiders.

8. A geographic information system (GIS) is an information system which keeps track of the particular relationships between data descriptive of people, buildings, land, and utilities, and spatial (or graphic) data which specify the location of the objects. For example, building "x", located at a particular position (x,y) (spatial data), is ten years old, has 10,000 square feet, and was repainted three years ago (descriptive data). Also, building "x" is adjacent to freeway 5 and to building "y" (relationship data). Put simply then, a GIS is a master index of people, buildings, land, and utilities with statistical, graphical, and query capabilities.

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Chapter IV

The Research Methodology

This chapter presents the research methodology used to test the framework and the hypotheses presented in Chapter 3. Before discussing the research design per se, we need to describe briefly the population from which the sample was drawn.

Unit of Analysis

The focus of the present study is on public sector organizations, more precisely on city governments. City governments are true corporations with legal standing. They provide a vast array of services to the population. These include such services as public safety (e.g. police and fire protection), public works (e.g. engineering, streets and highways construction and maintenance), and human resources (e.g. parks and recreation, administration, libraries).

There are three basic forms of government, two of which are of interest to us. In the *mayor-council* form of government, the mayor and the council are elected. Generally, the administrative responsibilities are concentrated in the hand of the mayor. The mayor appoints all top management personnel and prepares the budget. City council appropriates funds and sets revenue rates. The second most common form is the *council-manager*. The council is elected and

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appoints a professional manager to administer the municipal corporation. The manager reports to the council and communication links between the council and the administration is channelled through the professional manager. The position of mayor is usually ceremonial and held by a member of the council. In the *commission* form of government, the manager of each major department or unit is elected. There is no top executive manager, although one elected manager might serve as figurehead. We do not include cities with commission form because their organization structure is very peculiar and often quite awkward. Also, there are only a few city governments that are structured this way.

Notwithstanding whether they are elected or appointed, top executive city officials face the same challenge as top executives of other service organizations. They need to coordinate operations in the most efficient way, given certain budgetary constraints and provision of services. Focusing on city governments has several advantages and alleviates most of the problems previous studies experienced. First, there is no production technology that may confound the findings associated with IT. IT is the predominant technology. Second, the homogeneity of the sample is such that there are only small variations in the managerial roles across organizations. This facilitates the definition, operationalization, and measurement of the concept of middle management. Also, it permits a more precise definition and differentiation of the specific information systems most likely to affect the occupational profile of middle managers. The third advantage of studying an homogeneous sample is that it

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reduces the complexity of the study and, therefore, a more complete and richer understanding of the IT impact is more likely to be obtained.

One potential drawback of studying city governments is that, like other governmental institutions, city governments are reluctant to lay off personnel, more so than private sector organizations. Also, private sector organizations are more sensitive and responsive to external environmental conditions. Consequently the impact of IT on the number of middle managers is likely to be less pronounced in public sector organizations than in private sector organizations. However, this is not a disadvantage or a weakness of the study but rather a "risk" the researcher takes of finding no significant relationship. Obtaining significant relationships between IT and the occupational profile of middle managers in city governments is indicative of much wider IT impacts than the same finding in private sector organizations. One can predict that if IT affects significantly the number of middle managers in city governments, it is also likely to influence a wide variety of organizations in the private sector. Findings obtained in the private sector, however, can hardly be used to predict impacts of IT in public sector organizations. Significant findings in private organizations may not be significant in public organizations.

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Research Design

We use a mix of survey and case study. There are several advantages in the mixed design. A mixed design provides more complete information on the phenomenon studied and is therefore likely to provide encompassing findings and a richer understanding of the IT impact. The trend of the impact of IT on the number of middle managers may not be very pronounced and consequently, a large number of organizations needs to be studied to detect it. This is best addressed by survey research. Also, the process of change underlying the IT impact is dynamic in nature, and as such, it is best studied through a case study approach. Also, some concepts like the number of middle managers and the structure of computing decision making authority are best studied through the survey approach. However, because of their complexity, informality, and sensitivity, some concepts such as political maneuvers can hardly be assessed in a structured and concise format best appropriate to survey questionnaires. They are best researched using the case study approach.

In addition, a research design which includes case study provides greater flexibility than a design based on survey alone. This is particularly important in this study because, although there are some theoretical bases for developing structured questionnaires to measure the impact of IT on middle managers, most current knowledge on the phenomenon is speculative or anecdotal in nature. Therefore, it is difficult to determine in advance, based on prior research and theory, all the concepts to focus on and what questions to ask. The case

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approach, although it also requires some structure, permits study of the lesser understood and predictable aspects of the IT impact on middle managers. In short, mixing research methods permits a broader focus and a greater depth of analysis and yields a richer understanding. A mix of research methods also permits one to triangulate and validate data.

The following sections of this chapter describe in turn the survey design (sampling, index construction, analytical procedure) and the case study design (site selection, respondent selection, interview procedure, analytical procedure).

Survey

Design

The 1985 survey of U.S. cities is part of the larger twenty years Urban Information Systems study (URBIS) and is a longitudinal extension of the 1975 study. The 1985 survey starts by in-depth case studies of seven cities. The information thus obtained, supplemented by literature reviews and meetings with IS managers, is used to modify the 1975 questionnaires to reflect the changes in computing that have occurred during the last decade. The revised questionnaires are then reviewed by a group of IS managers, revised again, pretested with another group of IS managers, and then revised again.

Three questionnaires are thus developed. The "Management and Planning Survey" and the "Computers and Applications Survey" questionnaires are sent to the data processing installation managers. They survey all dimensions of

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managing computing and they provide a comprehensive inventory of computerized applications currently in operation and planned. The "Local Government Managers Survey" questionnaire is sent to top management (mayor, city manager, or assistant city manager) and measures the overall organizational and environmental contexts of each city (see Appendix B).

Sample

The population from which the sample of this study is drawn is made of 443 U.S. cities with a population of 50,000 or more in 1980. It was felt that the study of larger cities was appropriate because most smaller cities do not have sufficient levels of computing activity to affect the middle management workforce. Moreover, those cities have too few middle managers to show significant changes, even if the level of computing were great. The questionnaires were sent to all the 443 cities. The response rates are 71% for the two DP questionnaires and 73% for the top management questionnaire.

The final URBIS sample contains information on 310 larger cities (70% of the population). The final sample for this study consists of 155 larger cities. This is smaller than the URBIS sample because only a fraction of the data collected for the 1985 study is used in this study. A great quantity of items of the three questionnaires have no bearing on the present study. Also, responses to specific questions from all three questionnaires are needed for a city to be included in this study. Some cities have missing data and are therefore excluded from the analysis.

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Because the URBIS study contains information on 310 larger cities (70% of the population), we can test for sample bias with the larger sample. This cannot assure that the 155 cities are truly representative of the population, but it does provide very good indications. Table 4.1 presents the test of difference between the sample used in the present study and the URBIS sample.

Table 4.1
Test of Differences Between this Sample and the URBIS Sample

Characteristic (1985)	Mean: Study	Mean: URBIS	T value
Size related			
Number of employees	2,382.12	3,764.64	-1.63 #
Number of middle managers	118.53	155.55	-.89 #
Total number of managers	137.74	197.75	-.73
Ratio of middle managers	.76	.78	-.40
Population (1980)	164,020.32	223,853.27	.91 #
Organizational context			
Internal options[a]	36.98	39.58	-1.36
Fiscal option[b]	26.20	28.63	-1.39
External options[c]	13.81	13.58	.22
Government type[d]	1.79	1.64	1.87 #
Revenues (in millions)	118.66	183.19	-1.44 #
Expenditures (in millions)	108.96	176.12	-1.55 #
DP context			
Number of DP staff	24.71	23.68	.20 #
DP budget (in thousands)	1,684.59	1,710.29	-.06 #
Number of installations	1.14	1.17	-.42 #
Ratio of coordination applications	.01	.01	.33
Ratio of control applications	.32	.31	1.06
Ratio of efficiency applications	.04	.04	-.08
Access	.08	.06	2.04 # *
Total number of applications	83.66	84.50	-.16
Influence on DP decisions	12.41	11.77	1.52

* P<.05
** P<.01
*** P<.001

\# Indicates that the T-test is performed based on separate variance estimates. The assumption of homogeneity of the variance of the two groups is not satisfied. Otherwise, the T-test is based on pooled variance estimates.

a: Managerial options affecting the internal organization to mitigate revenue reduction (e.g. reduce the number of employees).

b: Managerial options using fiscal leverage to mitigate revenue reduction (e.g. increase tax).

c: Managerial options changing the local environment to mitigate revenue reduction (e.g. revitalize local economic base, provide incentives to retain local firms and to attract additional firms).

d: Whether it is a mayor (1) or a city manager (2) type of government.

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The T-tests presented in Table 4.1 indicate that the study's sample and the URBIS sample are similar on nineteen of the twenty organizational characteristics tested. The two samples differ significantly only with regard to the number of access points per employee. The 155 organizations used in this study have a slightly higher average number of access points per employee than the 310 organizations in the URBIS sample. This limits the generality of the findings where the number of access points is taken into account in interpreting those findings.

Four other variables seem different in the two samples. The number of employees, the number of middle managers, the revenues, and the expenditures are all smaller in the study sample than in URBIS's. These seem to indicate that the study's sample is made of smaller organizations that the population in general. Because the impact of IT on the number of middle managers is less pronounced in smaller organizations, the study's sample increases the generality of the significant findings of this study. However, note that these differences, although pronounced in appearance, are not statistically significant. This is so because the variance of the variables is large and unequal across the two samples.

Index Construction

This study is centered around four concepts: (a) extent of automation, (b) middle management, (c) structure of organizational decision, and (d) structure of computing decision. Recall that its primary objective is to explain the nature and the magnitude of the IT impact on the number of middle managers in local

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governments. Thus, city governments are the object unit of analysis. The measures of the structure of organizational decision and of the number of middle managers are taken at the organizational level. However, the measures of the extent of automation and the structure of computing decision are at installation level and need to be aggregated at the organization level. The procedures used to develop each index are described in the following sections.

Extent of automation. Recall that we measure the extent of automation based on three types of applications (control, coordination, efficiency) and on how widespread the access to these applications is.

The extent of automation is measured at the installation level. It is obtained by asking the DP manager of each installation to indicate which computer applications, from an exhaustive inventory of 539 applications, are in operation. Once we have a complete inventory of applications in operations in every installation, we then develop the three specific measures. Based on field work and on our knowledge of the applications, we count the number of control, coordination, and efficiency applications. In cities with multiple installations, an organization-wide measure is obtained by summing the installation measures for all installations in the city.

To minimize the size effect and to have a better measure of the intensity with which these applications are automated, the three indexes are divided by the total number of applications in operation in the city. These indexes are used rather than the indexes proposed in previous studies to reduce the effect of organization size. The indexes of previous studies are highly correlated with

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organization size: (a) number of hardware devices (r=.821), (b) number of functions automated (r=.280), and (c) annual DP budget (r=.710). Whereas the foregoing indexes are significantly less related to organization size. The Pearson correlation coefficients between the control, coordination, and efficiency oriented applications and size (number of employees) are -.160 (p=.01), .060 (p=.14), and -.030 (p=.30) respectively.

The last index used to measure the extent of automation is the degree of accessibility of the applications. This index is a simple count of the number of terminals and personal computers attached to the mainframe or the number of mini computers on which the applications described above run.

To better measure the accessibility and to limit the effect of size, the index is divided by the total number of employees in the organization. This gives a ratio that indicates how many access points there are per employee. The higher the score on this index, the more access points there are for each employee. A score of "1" means that each employee has one personal computer or terminal through which he/she can access the applications (assuming no employee has more than one access point). This index also has a lower correlation to organizational size (r=.150, p=.01).

Typically, in order to test indexes to determine how well the items hold together, one would perform a reliability analysis and a factor analysis. However, the indexes of the extent of automation are all composed of factual items, as opposed to attitudinal measures that tap a latent construct, and consequently, the interpretation of the reliability coefficient is meaningless.

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Also, all items are binary; that is, they can only take one of two values: operational or not. This substantially limits the variance in the scores and consequently, significantly weakens any interpretation of any tests based on covariance like factor analysis. In fact, the classification of the applications can only be validated through intersubjectivity verification based on knowledge of what the applications do and of how they are used. The classification of applications is validated with research professionals of the URBIS group who are very knowledgeable about the different applications.

Number of middle managers. Measuring the number of middle managers is relatively easy, especially with an homogeneous sample. City governments of comparable size have similar structures. Their number of hierarchical levels and the roles of managers are relatively constant across organizations. This facilitates the measurement of the concept because one definition of middle management is valid across organizations.

The data are gathered by asking top managers to define the number of managers corresponding to the definition of middle managers--managers above first level supervisors but below department heads. This item is included in the "Local Government Managers Survey" questionnaire. Because top managers might not know this information or have it readily available, it was recommended that they contact the city personnel director when in doubt.

The data are verified using frequencies analysis and several ratio analyses: ratio of middle managers to (a) top managers, (b) operations managers, (c) total number of managers, and (d) total number of employees. Sixteen organizations

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came out as exceptional cases, either because they had too many or too few middle managers compared to the rest of the sample. Follow-up telephone interviews with the respondents and, most of the time, with the personnel director of the sixteen organizations, indicate that only seven cities had in fact erred in answering the question. One city provided the corrected number of middle managers, and six cities could not determine the number and were entered as missing.

The number of middle managers is divided by the total number of managers in the organization. This makes a more meaningful and robust index. The ratio thus obtained represents the composition of the managerial workforce and how important middle managers are. Also, it can account for an actual change in the middle management workforce and for a proportionate change as well. For example, when middle management grows slower or decreases faster than the rest of the managerial workforce. Finally, the ratio-based measure is less related to organization size. While the number of middle managers highly correlates with organizational size ($r=.540$, $p=.000$), the ratio-based index shows a much lower correlation ($r=.250$, $p=.003$).

Structure of organizational decision making authority. Recall that the structure of organizational decision refers to the degree of concentration of authority to make decisions affecting the organization. The Aston scale of centralization is used to measure this concept. The questionnaire containing the scale of the structure of organizational decision, "Local Government Managers Survey," is filled out by top management of each city government. The city

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manager or equivalent city official is asked to indicate the lowest level in the organization at which twenty-three key decisions can be made.

To increase the validity of the index and make sure that it fits the organizational reality of city government, two aspects of the scale are modified slightly. First, the hierarchical levels are changed. The six generic hierarchical levels of the Aston scale are:

(a) "above chief executive,"

(b) "whole organization,"

(c) "all work flow activities,"

(d) "workflow subunit,"

(e) "supervisory," and

(f) "operating."

The six levels are renamed and a seventh level is added to give the following:

(a) "city council or commission (legislature),"

(b) "city manager or top administrative officer,"

(c) "assistant or deputy city manager,"

(d) "department head,"

(e) "division head,"

(f) "supervisor," and

(g) "direct workers."

Second, the wording of some questions is modified so that they better correspond to the city government reality. For example, the Aston scale has two items relating to marketing decisions--"marketing territories to be covered" and "extent

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and class of market to be aimed for"--that obviously do not relate to city government. The two items are modified to "determine service areas covered" and "determine the extent and type of services to be delivered."

The seven levels are given values of 1 for city council to 7 for direct worker. It is felt that in order to have a more complete and valid measure of the degree of centralization, only cities that answer to all twenty-three items of the index are included in the analysis. The numbers are then added for all the decision and divided by twenty-three to obtain a score of centralization ranging from 1 to 7. Smaller scores indicate centralization and larger scores indicate decentralization.

The reliability analysis indicates that each item is highly correlated with the other items taken as a group (item-total correlation coefficients ranging from .250 to .620 with the majority of them around .450; see Appendix C). Also, the scale yields a reliability alpha of .8631 and a standardized alpha of .8630, and every item contributes positively to the scale ("alpha score if item deleted").

Structure of computing decision making authority. The structure of computing decision refers to the degree of concentration of authority to make significant decisions regarding computing. The initial measure contains three indexes: the number of installations, the influence over computing decisions, and the involvement in computing decisions. The first index is the *number of installations* in the organization. Recall that an installation is a set of hardware with staff directly responsible for operating the system and installing and maintaining applications, which operates more or less independently of other

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computer installations. This is therefore an index of how concentrated the decisions regarding operations are. This index is measured by counting the number of installations in the city. The larger the number of installations, the more decentralized the structure.

The second index measures *which individual or group is the most influential* in making key decisions in four areas: (a) prioritizing new applications, (b) approving budget for major and minor computer purchases, (c) evaluating the services of an installation, and (d) deciding on major organization arrangement changes. The DP manager of every installation indicates who, among (a) the DP manager, (b) the department head over DP, (c) the user department heads, (d) the chief administrative officer, or (e) the local legislative body, is the most influential for each decision.

Two notes need to be made about the influence index. First, twenty-eight cities have multiple computer installations and a decision has to be made regarding which installation influence index will be used as the city-wide surrogate. Contrary to the previous installation level measures, it is inappropriate simply to add the indexes to obtain a city-level measure. Scores of installations with different importance and size do not, and cannot have the same weight in assessing the overall concentration of computing decision making authority. (See Appendix D for the list of the cities with multiple installations.) For example, the score of the central computing installation--where most important applications are developed and managed and where the greater part of the budget is invested--cannot not be considered equal to the score of a library installation.

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Consequently, we need to choose the installation with the influence score that most adequately represents the city-wide degree of concentration of computing authority. To do so, knowledge based on field work and the following criteria are used:

(a) the department in which the installation is located,

(b) the structural arrangement of the installation (independent versus subunit of a department),

(c) when the installation started providing services,

(d) the annual budget, and

(e) the number of staff.

Generally, preponderance is given to installations in an independent DP department under a chief executive and to the older and larger installations.

The second important point regarding the construction of the index of influence is that the classification of the individuals or groups as middle managers, department heads, or top managers needs to be adjusted according to the structural arrangement of the installation. Recall that the five actors are the DP manager, department head over DP, user department heads, chief administrative officer, and local legislative body. In an installation which is a subunit of a department (e.g. finance, police, etc.), the DP manager is in fact a middle manager, while the department head over the DP manager and the user department heads are department heads. The chief administrative officer and the local legislative body are top managers. When an installation is an independent DP department reporting directly to the chief executive, the DP manager and the

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user department heads are department heads. The department head over DP, the chief administrative officer, and the local legislative body, are top management. The latter arrangement is more centralized than the former and must be accounted for as such.

The third index of the structure of computing authority is *which individuals or groups are involved* in key computing decisions regarding the same four areas as in the influence index. This index is measured the same way as the influence index.

The Pearson correlation coefficients indicate that the three indexes are highly correlated. The degree of influence has a coefficient of correlation of .47 ($p=.000$) with involvement and of .130 ($p=.02$) with the number of installations. Whereas the involvement index has a coefficient of .160 ($p=.01$) with the number of installations. It seems that the three indexes tap a common concept believed to be the structure of computing decision.

To keep the analysis as simple as possible, only the influence index is used. The influence index is the one that best corresponds to the essence of the conceptualization of the structure of computing decision. It directly taps who influences and controls the major decisions concerning computing in organizations. Also, the influence index is the least related to organization size.

Involvement is a necessary element of influence, but it alone is not sufficient because it does not indicate differential power and influence. The number of installations is also a good measure, but it tends to relate to

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operational decisions and potential impacts of a lesser importance than the influence index.

The statistical analysis indicates that the influence index is reliable yielding a standardized and an unstandardized alpha of .750 (see Appendix E). Also, the analysis indicates that every item is highly correlated with the others taken as a group ("item-total correlation coefficients" ranging from .37 to .61). All items contribute positively to the overall scale ("alpha if item deleted"). Finally, the factor analysis indicates that all six items measure one common concept believed to be the concentration of computing decision and that they explain more than 45% of its variance.

Analytical Procedures

Recall that the hypotheses predict that the impact of IT on the number of middle managers will be moderated by the structures of organizational and computing decision. Ideally, such a theory is tested by a three-way interaction terms analysis, which entails a hierarchy of four regressions: regressing the dependent variable (ratio of middle managers) on:

(1) IV

(2) IV, MV1, MV2

(3) IV, MV1, MV2, (IV * MV1), (IV * MV2), and

(4) IV, MV1, MV2, (IV * MV1), (IV * MV2), (IV * MV1 * MV2)

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where IV = independent variable (the extent of automation)

MV1, MV2 = moderator variables (the structure of computing authority and the structure of organizational authority)

Such an analysis has the advantage of preserving the information provided by the two continuous moderator variables that would be lost through degrading them to dichotomies and a 2 X 2 factorial design. However, a three way interaction terms analysis is very complex, and the results are very difficult to interpret. Also, it can lead to serious problems of multicollinearity[1] that often cannot be corrected. The solution is to split the sample on one moderator variable and perform a simpler and more robust two-way interaction terms analysis in each group.

We dichotomize the structure of organizational decision and use the structure of computing decision as the continuous variable in the interaction terms. This decision is motivated by the fact that the concept of concentration of computing decision making authority is central to the present study and we want to preserve the information the continuous variable provides. Also, the index has a larger variance in scores than the index of the structure of organizational authority. And the larger the variance of the variables composing the interaction terms, the smaller the correlation between the independent variables, and the less likely multicollinearity problems will occur. Tests will be conducted to detect problems of multicollinearity in the regression analyses.

Method to split a sample. There are two basic ways to split a sample: the median method and the theory-driven method. The *median method* uses the median score of the variable of interest to split the sample and obtain two groups

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of equal size. This method generates one group of organizations that are relatively centralized and another group of organizations that are relatively decentralized. The important point to note here is that this method classifies organizations in a relative matter, that is by comparing them to the overall sample. This method has the advantage of being simple to use. On the other hand, the median method generates results that are sample specific and that cannot easily be generalized to other samples or to the population of interest. For, an organization in one sample may be classified as centralized in a particular sample and as decentralized in another sample. A second problem is that any sample is likely to be skewed, even slightly, and therefore the median method is likely to group organizations together that are in fact different. This is likely to confound the results and the interpretation. Finally, the median method is a-theoretical in that it relies on statistical properties alone to form the groups.

The *theory-driven method* splits a sample based on some theoretically defined cut-off points. The organizations are not classified in relation to other organizations in the sample but rather in relation to preset, theoretically driven criteria. This theory-driven method has the advantages of classifying organizations based on their intrinsic characteristics rather than based on their relative score on a given variable. The findings and the interpretation obtained using this method are more robust and general than the ones obtained by the median method. The obvious disadvantage of this method is that it may be difficult to determine the cut off-point. Also, if the sample is skewed, one sub-sample may have too few cases to permit worthwhile statistical analysis.

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This study uses the theory-driven method for two additional reasons. First, there is a predefined cut-off point in the measure of the structure of organizational decision. Recall that the measure asks managers to indicate the lowest level at which twenty-three decisions can be made. The seven organizational levels provided are: (a) "city council," (b) "city manager," (c) "assistant city manager," (d) "department heads," (e) "division heads," (f) "supervisors," and (g) "direct workers." Organizations are classified as centralized when their average score is at or above "assistant city manager," and as decentralized when their score is below "assistant city manager." This is based on the fact that managers of the three higher levels of the hierarchy are responsible for and make decisions relating to the overall organization. They are not tied to particular sub-units of the organization, but rather they personify and make decisions in the interest of the overall organization. Managers of the four lower levels are tied to particular sub-units, departments, or groups and are consequently likely to make decisions that are more oriented toward the interests of the sub-units than toward the interests of the overall organization. The second reason for using the theory-driven method is that the sample is relatively normally distributed and the two groups are of comparable size. Statistical analyses can be performed on both groups with the advantage of obtaining robust and general findings.

The centralized group thus formed has 86 organizations, and the decentralized group has 69 organizations. The two groups are tested for

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difference on twenty organization characteristics. Table 4.2 presents the results of this test.

Table 4.2
Test of Differences Between the Two Sub-Samples

Characteristic (1985)	Organizations	Organizations	T value
Size related			
Number of employees	2585.81	1715.18	1.13 #
Number of middle managers	112.89	106.85	.23
Total number of managers	132.79	125.54	.26
Ratio mid-manager/total	.75	.77	-.72
Number of functions[a]	25.50	25.59	-.11 #
Population (1980)	183,932.27	130,004.75	1.08 #
Organizational context			
Internal option[b]	36.92	37.22	-.16
Fiscal option[c]	26.18	26.29	-.07
External option[d]	13.98	13.52	.46
Government type[e]	1.89	1.81	.92 #
Revenues (in million)	127.59	84.17	1.13 #
Expenditures (in million)	115.45	78.99	1.09 #
DP context			
Number of DP staff	30.09	19.24	1.22 #
DP budget (in thousand)	2014.77	1347.18	.96 #
Number of installations	1.19	1.03	1.99 #
Ratio of coordination appl.	.01	.01	.00
Ratio of control applications	.32	.32	-.08
Ratio of efficiency applications	.04	.04	-.51
Access	.08	.09	-.49 #
Total number of applications	87.28	81.58	.75 #
Influence on DP decisions	8.95	9.39	-.92

* P<.05
** P<.01
*** P<.001

\# Indicates that the T-test is performed based on separate variance estimates. The assumption of homogeneity of the variance of the two groups is not satisfied. Otherwise, the T-test is based on pooled variance estimates.
a: Number of functions performed by the city.
b: Managerial options affecting the internal organization to mitigate revenue reduction (e.g. reduce the number of employees).
c: Managerial options using fiscal leverage to mitigate revenue reduction (e.g. increase tax).
d: Managerial options changing the local environment to mitigate revenue reduction (e.g. revitalize local economic base, provide incentives to retain local firms and to attract additional firms).
e: Whether it is a mayor (1) or a city manager (2) type of government.

Table 4.2 indicates that there are no significant differences between the centralized and decentralized organizations. The theory-driven method can be used to split the sample with the assurance that the two sub-samples thus generated are similar and comparable otherwise.

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Multicollinearity test. Problems of multicollinearity will be tested in the analysis in two ways because no one way provides irrefutable evidence. First, a common warning that a multicollinearity problem is present is the correlation of independent variables at .80 or more. The second and preferable test to detect problems of multicollinearity is performed by regressing each independent variable in the equation on all other independent variables. If the R^2s are close to 1.00, there is a high degree of multicollinearity present (Althauser, 1971; Berry and Feldman, 1989; Lewis-Beck, 1987).

If multicollinearity is present, the method proposed by Smith and Sasaki (1979), which consists of subtracting means from each of the two component variables in the interaction terms, will be used. This transformation does not affect any of the statistical properties of the interaction terms or of other independent variables. It simply partitions the total effect of all the independent variables in the equations so that it reflects the "real" effect of each variable.

Regression procedure. The regression procedure used in the present study is as follows. First, a hierarchy of three regressions is run for the overall sample, and multicollinearity problems are tested. Then, the sample is split into two groups (centralized and decentralized organizations), and the hierarchical regression analysis is redone for each group.

The hierarchical analysis entails regressing the dependent variable (ratio of middle managers) on:

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(1) IV, CV

(2) IV, MV, CV,

(3) IV, MV, (IV * MV), CV

where IV = independent variables (extent of automation) CV = control variable (size)

MV = moderator variable (structure of computing authority)

In this study the dependent variable is the ratio of middle managers to the total number of managers (*ratiomm*), the independent variables are the extent of automation, which is measured through four indexes of the extent of automation (*control*, *coordination*, *efficiency*, *access*), and the moderator variable is the structure of computing decision (*influence*). The control variable is included in all the regressions, but it never becomes part of the multiplicative terms. In this study we want to control for the effect of organization size (*logemp*). The number of employees is used as the measure of organization size for three reasons. First, it is the most common measure used in MIS (Blau et al., 1976; Carter, 1984; George, 1986; Klatzky, 1970; Lehman, 1985; Pfeffer and Leblebici, 1977). Second, it is general, easy to obtain and assess, and easy to compare across studies. Third, and most importantly, the number of employees is the measure that accounts for the greatest portion of the variance in the independent and dependent variables. Therefore, controlling for its effect will assure that size is not confounding the results. The regression analyses use the log (base 10) of the number of employees in the organization because the relationship between organization size and organization structure is not linear. However, the

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regressions assume linear relationships between the independent and the dependent variables. Taking the log of the number of employees permits performance of analyses as if the relationships were linear.

The hierarchical procedure used in this study is to regress *ratiomm* on:

(1) control, coordination, efficiency, access, and logemp,

(2) control, coordination, efficiency, access, influence, and logemp, and

(3) control, coordination, efficiency, access, influence, (control * influence), (coordination * influence), (efficiency * influence), (access * influence), and logemp.

Interpretation of the Regressions

The substantive theory and the framework discussed in Chapter 3 lead to analysis and interpretation of the regressions performed in the two sub-samples. The hierarchy of regressions based on the overall sample is used to test the significance of the moderating effect of the structure of computing decision and of the structure of organizational decision. The regressions are interpreted following a three step procedure.

First, *whether the structure of computing decision is alone sufficient to explain a larger proportion of the variance in the ratio of middle managers* is determined. A significant increase in the R^2 from regression 2 to regression 3 for the overall sample indicates that the structure of computing decision does in fact moderate the IT-middle managers relationship. The following F-test indicates if the change in R^2 is statistically significant or not:

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F-test $= [(R^2_3 - R^2_2) / (1 - R^2_3)] * [(N - K_3 - K_2 - 1) / K_3]$

$(df = K_2, N - K_3 - K_1 - 1)$

R^2_3 is the R^2 of the regression with the interaction terms (the third regression described above),
R^2_2 is the R^2 of the regression with the independent variables and the moderating variables but without the interaction variables (second regression),
K_3 is the number of independent variables added in the third regression (number of interaction terms),
K_2 is the number of independent variables in the second regression (excluding the constant),
N is the sample size.

Second, *whether the structure of organizational decision alone explains a larger portion of the variance in the ratio of middle managers* is tested. The hierarchy of regressions for the overall sample is used as the benchmark to determine whether or not splitting the sample into centralized and decentralized organizations adds significantly to the explanation. A significant difference between the R^2s of the first regression of two sub-samples and the R^2 s of the first regression for the overall sample indicates that the structure of organizational decision does in fact moderate the IT-middle management relationship.

Third, *the regression equations* are calculated and plotted. Recall that an equation with an interaction term contains in fact a multitude of equations, because various values of the moderating variable can be substituted to observe the change in coefficients in the independent variables. The effect of the independent variable on the dependent variable are examined further by substituting the values of one standard deviation above the mean and of one

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standard deviation below the mean of the moderating variable into the equation (Cohen and Cohen, 1988). To determine the effect of the IT variables, the values of one standard deviation above the mean and of one standard deviation below the mean of each IT variable are substituted in the equations. The resulting equations are then plotted to obtain a graphic illustration and facilitate interpretation.

It is important to note that in a hierarchical regression analysis such as this one, all the interaction terms of substantive interest are included in the analysis, even if some are not statistically significant (Cohen and Cohen, 1988). This is appropriate because we are interested in determining and understanding the overall effect of IT. The statistical significance and the standardized coefficients can be used to determine the relative importance and influence of each interaction term in a given sample.

Also, the main variables are not interpreted. Recall that the framework and the hypotheses relate to the interaction terms only. Also, the interpretation of the interaction terms preclude an interpretation of the main effects (Cohen and Cohen, 1988). The interaction terms indicate that the effect of the main variables is conditional or depends upon the value of the moderator variable. Therefore, it is inadequate to interpret the main effects as if they were constant across organizations.

The index construction and statistical computations will all be performed on the IBM 9375 mainframe computer at the Public Policy Research

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Organization at the University of California at Irvine. The SPSSX programs can be found in Appendix F.

Case Study

The case study supplements the survey analysis in three ways. First, it provides a preliminary test of the findings obtained in the survey analysis. Second, the case study completes the understanding and refines the explanations drawn from the survey. It assesses the dynamic process occurring between the factors found important in the survey and it makes other important factors visible (e.g. power struggle, information withholding). Third, the case method permits the study of the motivations behind managerial actions, which are so important in understanding the IT impacts.

Type of Case Method

First, a decision needs to be made regarding the type of case study that will be used: historical--retrospectively focused on events--or on-going--focused on the present situation and how people react to it. Both approaches are used in this study because the IT intervention typically evolves over a period of time and entails a dynamic process. Therefore, we focus on changes in IT and managerial structure that have occurred in the recent past and that are occurring in the present situation.

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Data Collection

Sites selection. The two cities were chosen according to the following criteria. First, the expected literal replication is favored (i.e. similar results at the two sites) over theoretical replication (opposite results). Two organizations with an extensive centralization structure are chosen because this is how the argument has been set up in the literature. Also, this is where the most observable IT impact is supposed to occur.

Second, because this study deals with the effect of computing on middle managers, the sites were also selected so that they include departments where the information systems that are most likely to affect middle managers are intensively computerized, as well as other departments where the extent of automation is low. The 1985-86 URBIS data and field work indicate that typically, the highly automated functional areas are:

(a) public safety (police, fire),

(b) finance and administration (accounting, budgeting, and management),

(c) general government, and

(d) public works and utilities (planning and zoning, engineering, transportation).

The community development and human resources (public health, parks and recreation) departments are also included in this study, but because they have a very low degree of computerization, they serve as "quasi control groups."

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The two sites were chosen using the following procedure. First, two organizations with extensively centralized structures, differing in several characteristics, were chosen. Second, an introductory letter explaining the nature of the research and what participation as a case study would involve was sent to the city managers of each city. Third, a telephone interview with the city manager or assistant city manager was conducted to verify the classification of each city and to secure its participation in the project. Then a meeting with each city manager was set up to detail the plan of the case study and to schedule interviews.

Respondent selection. As can be seen from Table 4.3, the four concepts of interest and the context of the organizations were discussed with several respondents. This assures completeness of the information gathered and it increases its validity. (Appendix G contains the complete interview guides.)

Table 4.3

Respondents in the Two Cities

		Variable	Respondent
1. Organizational Context	-	Characteristics of the organization (number of employees, structure, annual budget...)	ACM, DH, PD
	-	Recent evolution in the organizational context (over the last 5 years)	ACM
2. Information Technology	-	Characteristics of computing (role, orientation, budget, equipment..)	ACM, DP
	-	Sophistication	DP
	-	Extensiveness	DP
3. Organizational Structure	-	Degree of centralization	ACM, DH, DP, MM
	-	Roles of middle managers	ACM, DH, MM
4. Structure of Computing Decision Authority	-	Who participates in and influences what decisions	ACM, DH, DP, MM
5. Perceived Impact of Information Technology	-	Number of middle managers, roles of middle managers, degree of centralization	DH, DP, MM
	-	Managerial motivation	ACM, DH, DP, MM

ACM: assist. city manager MM: middle managers DP: data processing DH: department head PD: personnel director

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The author interviewed the assistant city manager of the two cities to gather information about external and organizational contexts and about the roles of the DP department in the city. The data processing manager of each city was interviewed to provide specific information about its IT use. The personnel director of each city was interviewed to provide information about the evolution of the occupational profile of middle management in the organization. The author also interviewed the heads of the departments of interest to acquire specific information pertaining to each department. Two middle managers were also interviewed in each department so that they might explain their specific roles and use of IT. In the community development and community services departments, two group interviews with middle managers were conducted.

Interview method. The author conducted nineteen and sixteen semi-structured interviews in City A and City B respectively. (There is a difference of three interviews because in City A, public works and public services are two separate departments, whereas in City B they are under the public works department.) Each interview started with a brief discussion of the research project, carefully designed to arouse the attention and interest of the interviewee, while not biasing his/her responses by providing too much information about the framework, hypotheses, and survey results. The core of the interviews was semi-structured. Each interview was based on a precise list of topics to be discussed with the respondent, but the interview was relatively unstructured and took the form of directed discussions. The interviews ended with open discussions of the

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research and with questions the interviewees wanted to ask (see interview guides in Appendix G). All interviews were tape recorded.

Multiple data collection was also used to complement and validate data gathered in the interviews. Specifically, annual budgets (1983 to 1988), detailed job descriptions of the respondents, and detailed organization charts were used.

Analytical Procedure

The analytical procedure for the case study contains three major steps. First, the verbatim transcript of each interview is written following the structure of the interview guide. Second, using a process similar to content analysis, the interview transcripts are aggregated to obtain a department level exhaustive description of twelve characteristics grouped in four broad dimensions, as shown in Table 4.4 below.

Table 4.4
Dimensions and Characteristics Describing the Departments and the Organizations

1. Information Technology
    - 1.1 Sophistication
    - 1.2 Extensiveness
    - 1.3 Utilization of computing

2. Roles of Middle managers
    - 2.1 Importance (interpersonal, informational, and decisional roles)
    - 2.2 Degree of standardization, routinization

3. Structure of Computing Decision Making Authority
    - 3.1 Control of planning and prioritization of applications
        - 3.1.1 Role of the DP manager
        - 3.1.2 Role of middle managers
        - 3.1.3 Political behavior of middle managers
    - 3.2 Control of computing operations

4. Impact of IT on Middle managers
    - 4.1 Number of middle managers
    - 4.2 Roles of middle managers
    - 4.3 Centralization/decentralization of decision making authority

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Each department is described according to these four dimensions by three respondents. Finally, to obtain organizational level data comparable to the survey results, the department level descriptions are aggregated to the organization level using the same process and the same dimensions and characteristics as those used for the department level aggregation.

Sites Description

Environmental and organizational contexts. Table 4.5 presents a general overview of the environmental and organizational contexts of City A and of City B.[2]

Table 4.5
Environmental and Organizational Contexts

	City A	City B
County, State	Orange County, California	Orange County, California
Local economy	Growing, healthy	Growing, healthy
Government type	City manager	City manager
Number of councilors	5	5
Number of managerial levels	5	5
Number of middle levels	2	2
Population	97,000	105,000
Number of employees	572	742
Employees/1000 population	5.9	7.1
Operating budget	$47,819,000	$57,175,989

City A is a city manager type of government made of a mayor, five councilors, and a city manager. It is a very fast growing city. In the last two to three years, its population has grown at a rate of about 12,000 persons per year. In 1980, its population was 62,134 and it has now reached 97,000. Its number of employees has also grown rapidly, from 422 in 1985 to the present 572. It has 6

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employees per thousand population (1988). City A has an annual operating budget of $47,819,000.

City B is also a city manager type of government made of a mayor and five councilors, and a city manager. It is also a fast growing city, although not to the extent of City A. In the last couple of years, City B has grown at about 3,000 to 4,000 citizens per year. Its present population is 105,000 and it was 91,788 in 1980. City B is considerably bigger than City A. It has grown from 609 employees in 1985 (44% more than City A) to an actual 742 employees (30% more than City A). City B has an employees per thousand population ratio of 7. Its operating budget is $57,175,989 (20% larger than City A).

Both cities suffered decreasing revenues from the federal and state governments in the past five years. However, because they are in a healthy and growing local economy, they experienced increasing municipal revenues, generated primarily through sales tax, which partly offset the decreasing revenues from the other sources.

The two cities chose different options to mitigate revenue reductions. City A, increased license and permit fees, bond financing use for capital projects, and long-term municipal debt. Also, in order to fill its six-million-dollars operating deficit, City A raised taxes and reduced internal operating expenditures. Finally, City A decided to temporarily reduce the number of new employees hired and to eliminate some vacant positions. On the other hand, City B favored revitalizing local economic bases, providing incentives to attract new firms as well as to retain local ones. City B also increased monitoring of revenues owed, accelerated

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collection of revenues, increased license and permit fees, and established new fees for selected services. Finally, City B, unlike City A, opted to restrain increases in employees' fringe benefits rather than reducing the number of new employees hired. Over the last year, both cities have been able to mitigate revenue decreases and have experienced increasing revenues.

City A and City B have similar hierarchical structures. There are five levels of managers: (a) city managers, (b) department heads, (c) division managers, (d) superintendents, and (e) first level supervisors. Consequently, "middle management" includes the division managers and the superintendents.

As discussed earlier, both cities were chosen because they have a centralized structure of decision making authority. This was verified in the interviews with the city managers and with the department heads. They were asked to discuss at what hierarchical level and following what procedure the following decisions were made:

(a) create/delete a department, a service, a supervisory position,

(b) hire/fire and promote a supervisor,

(c) change the responsibility of a supervisor,

(d) choose a supplier, and

(e) set price limits for particular equipment.

Also, they were asked to indicate how much unallocated/unbudgeted money can be spent at what level of the hierarchy without authorization. The decisions correspond to the survey measure of the organization structure of decision making authority. The responses were then compared with the cities'

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centralization scores in the URBIS sample, and it was found that, in fact, both cities are clearly centralized.

Neither city performed significant internal organizational changes over the last five years. Overall, the two cities have similar environments. They both suffered reductions in revenue but mitigated them somewhat differently. City B mostly favored external and fiscal options while City A also used internal organizational options, more precisely reduction in new employee hiring. We saw also that City B is considerably larger than City A, which, however, grows more rapidly.

Computing context: City A. City A first established a formal computer installation in 1978. The information services unit is part of the administrative services department, which reports directly to the city manager. The information services unit is headed by the DP manager and has 17 staff professionals. Its 1987-1988 budget is $1,082,847 and is growing constantly. City A, as most organizations usually do, first automated the basic operational information systems (i.e. maintenance, purchasing, accounts receivable/payable, payroll, and inventory systems). In the last three to four years, the development efforts have been refocused. Most operational systems being automated, the city has begun to develop management oriented systems (i.e. budgeting, simulation, geoprocessing, vehicle dispatching, and manpower resource allocation systems). City A has now reach a relatively high level of automation. It has a total 180 applications in operations, 69 of which are applications likely to affect the middle managers occupational profile. Ninety-four percent of those are in public safety, finance

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and administration and general government, and public works and utilities. The community development and human resources departments share the remaining 6% of the "middle management applications."

Concerning the control applications, almost all maintenance and inspection records and scheduling, vehicle and manpower resource allocation, inventory management, license enforcement, and budgeting, accounting, and treasury collection systems are in operation. The coordination systems are also automated. Three of the five applications comprising the geographic information system are in operation. Finally, the electronic mail, word processing, and statistical analysis systems (efficiency applications) are also operational. City A has about 230 personal computers and terminals attached to the central computer, which gives a ratio of terminal to employees of almost .50, or one access point for every two employees.

Finally, City A has a relatively centralized structure of computing decision authority. The department heads, data processing manager, and the other managers were asked how much power and influence they have in the decisions regarding (a) prioritizing new applications, (b) approving budgets for major and minor computer purchases, (c) evaluating the service of the installation, and (d) deciding on major organizational arrangement changes. These are the same decisions used in the survey to measure the structure of computing decision authority. The answers indicate that City A has in fact a centralized structure of computing decision making authority. The computing decision process is centralized at the department heads level. The DP manager controls most

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computing decisions. She is the most influential and powerful member of the steering committee (composed of her, the other department heads, and the city manager). The DP manager plans and establishes the priorities of the different applications by interviewing the department heads of the city. In terms of development, the requests for new applications have to be approved by the department head (in the event they are made by lower level managers) and also by the DP manager, who determines whether or not they fit the plan.

The operations are also centralized. There is one central computer on which almost all applications are developed. Some independent applications are allowed to be developed on personal computers, but they are very minor and of little importance. Although the hardware configuration may not always be a good surrogate for the degree of centralization of computing decision, in this case it does reflect the authority distribution. It seems to be a direct result of the favorable bias of the DP manager toward centralization of computing. She orients computerization toward the central computer, and she tries to limit as much as possible the use of personal computers (PCs).

Computing context: City B. City B's computer installation began providing services in 1976. From 1976 to 1983, the installation was an independent data processing department reporting directly to the senior assistant to the city manager. However, in 1983, the DP manager retired and the city manager felt that the department, then made of 4 programer-analysts, did not achieve its fundamental objectives. There were some software and hardware problems

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(compatibility, expendability, etc.) and the DP personnel were not making good progress in developing computerized applications.

The city manager decided to switch to a facilities management company in 1984. The MIS function has been filled since that time by a computer service team made of 6 to 7 programmers and analysts who serve basically as consultants and report directly to the senior assistant to the city manager. The service team does not have any authority or power over any computing decisions. It is the senior assistant to the city manager who controls the computing process. She is the chair of the steering committee, which is also composed of the department heads. The senior assistant to the city manager establishes the plan and priority of the applications and develops important requests for new applications. The minor requests are also approved by the steering committee. The service team is basically an executant of the decisions made at top management level. The yearly budget devoted to data processing is $846,765.

Like City A, City B also began automating operation information systems. It first automated the budgeting and finance systems, and the inventory, maintenance, and records systems. In the last few years, the focus has been on revamping the old operation information systems and developing management oriented applications (i.e. simulation, modeling, and manpower allocation systems). Overall, City B has also reached a relatively high degree of automation, but not to the extent of City A, especially with regard to the management support systems. City B has a total of 131 computer applications in operation, 41 of which are applications likely to affect middle managers. Ninety-eight percent of

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those applications are in public safety, finance and administration and general government, and the public works and utilities departments. The community development and human resources departments share the remaining 2% of the "middle management applications."

The control systems are highly automated. Most of the information systems are operational except the manpower allocation and the vehicle dispatching systems. The coordination and efficiency applications are less automated than in City A. Only two of the five geographical information systems are in operation. Concerning the efficiency systems, the word processing, statistical analysis, and modeling are operational, but the electronic mail and calendaring are not. City B has about 220 personal computers and terminals attached to the two minicomputers, which represents an access ratio of .30, or one access point for every three employees.

Finally, computing decision making is centralized higher up in the organizational hierarchy in City B than in City A. This was verified following a similar procedure to that used for City A. Here again, City B clearly demarcates itself from the 310 cities in the URBIS data bank as having a centralized structure of computing decision authority. Recall that most decisions regarding major and minor aspects of computing in City B are made by the senior assistant to the city manager or by the steering committee headed by the senior assistant to the city manager. The hardware configuration is somewhat less centralized than in City A. There is a greater mixture of personal computers and minicomputers. But the major applications are all on the central computers.

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Summary: City A and City B

Overall, City A and City B share some common features. The external environment of City A and City B is similar. They both suffered reductions in revenues four years ago; however, their growing and healthy local economies permitted them to mitigate these decreases in revenues.

However, City A and City B are also quite different in several respects. While City B favored external and fiscal options to mitigate revenue reductions, City A also used internal options, like reductions in new employees hired. Regarding the computing context, City A is significantly more automated than City B, especially in those applications most likely to affect middle management. The control applications are highly computerized in both cities, but the coordination and efficiency applications are significantly more automated in City A. The number of access points per employee is also higher in City A than in City B.

The next chapter presents the results from the survey analysis. It discusses the hierarchies of regressions for the overall sample and for the two sub-samples (centralized and decentralized organizations). It also compares the results with the hypotheses to see which ones are supported. The findings based on the case study are presented in Chapter 6. The survey and case study findings are interpreted and discussed in Chapter 7.

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Endnotes

1. Multicollinearity is a statistical problem that arises when the correlations between independent variables are extremely high, making it impossible to separate the effect of one independent variable from those of others.

2. The names of the two cities are not mentioned in accordance with an agreement of anonymity with the cities.

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Chapter V

Findings from the Survey Analysis

Chapter 4 defines the variables studied and constructs the indexes to measure them. It also introduces the two sites used in the case study. This chapter presents the findings from the survey analysis. First, it presents the findings of the statistical analysis for the overall sample. Then, it splits the sample into organizations with a centralized structure of organizational decision and those with a decentralized structure of organizational decision, and performs the statistical analysis for each sub-sample. It concludes by discussing what the findings mean for the hypotheses. Chapter 6 presents the findings from the case study and summarizes the survey and the case study findings. It concludes by discussing what the two sets of findings mean for the framework presented in Table 3.1.

Analysis of the Overall Sample

Correlation Analysis

Before actually performing the regression analysis, we need to analyze the correlation between the independent and dependent variables to detect any anomalies. Table 5.1 presents the mean, standard deviation, and partial

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correlation coefficients of the variables used in this study. Recall that the effect of size is controlled for in the analysis.

Table 5.1
Independent and Dependent Variables' Mean, Standard Deviation, and Partial Correlation
(Overall sample, controlling for size: LOGEMP)

Variable	Var. name	1	2	3	4	5	6	7	Mean	s.d.
1. Organizational centralization	(CENTRAL)	1.00							2.996	.647
2. Computing centralization	(INFLUEN)	-.05	1.00						12.442	3.526
3. Control systems	(CONTROL)	-.03	-.11	1.00					.321	.100
4. Coordination systems	(COORDI)	.04	.02	-.16*	1.00				.008	.013
5. Efficiency systems	(EFFICI)	.09	.01	-.11	.05	1.00			.037	.029
6. Access	(ACCESS)	.09	-.11	-.22**	.23**	.16*	1.00		.078	.070
7. Middle manager	(RATIOMM)	.05	-.08	.19*	.14	-.05	.13	1.00	.749	.173

* P<.05
** P<.01
*** P<.001

We can make two observations based on the data of Table 5.1. First, the control, coordination, and efficiency applications are significantly related to the number of access points (*access*). As expected, the coordination and efficiency oriented applications are positively correlated with the number of access points. These applications are developed and used to facilitate the transmission of information between individuals, and consequently more applications also mean more people needing access to them. Quite surprisingly however, the control oriented systems are negatively associated with access. This can be explained by the fact that the essence of control oriented systems is precisely to control and limit actions, which also includes limiting access to the applications.

The second observation is that the control oriented applications are significantly negatively correlated with the coordination applications, and, although not statistically significant, with the efficiency applications. This provides support to the classification of applications into control, coordination,

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and efficiency. It reflects the fact that organizations, given certain budgetary constraints, orient their overall computing either toward controlling and limiting actions and monitoring performance, facilitating horizontal exchange of information, or toward favoring increases in efficiency.

Collinearity and Residuals Analyses

Before actually performing the regression analysis, we need to test for multicollinearity problems. To do this, each independent variable is correlated against each other, and each independent variable is regressed on all other independent variables. Very high correlation coefficients (r>.80) and R^2s close to 1 indicate the presence of collinearity problems. Table 5.2 presents the correlation and regression coefficients.

Table 5.2
Main Variables and Interaction Terms' Correlation and R^2 Coefficients
(Overall Sample)

Variable	1	2	3	4	5	6	7	8	9	R^2
1.Control	1.000									.933***
2.Coordination	-.158*	1.000								.932***
3.Efficiency	-.076	.061	1.000							.932***
4.Access	-.156*	.162*	.243*	1.000						.939***
5.Influence	-.069	.003	.026	-.079	1.000					.943***
6.Control * Influence	.694***	-.096	-.100	-.177*	.646***	1.000				.961***
7.Coordination * Influence	-.152*	.957***	.060	.130	.196**	.013	1.000			.935***
8.Efficiency * Influence	-.158*	.064	.900***	.760*	.364***	.092	.114	1.000		.937***
9.Access * Influence	-.181*	.167*	.216**	.912***	.254**	.028	.197**	.265***	1.000	.944***

* P<.05
** P<.01
*** P<.001

Table 5.2 clearly indicates that there are collinearity problems. All IT-related variables are very highly correlated with the interaction term in which they are a

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component (r between .700 and .960). Also, and more indicative, the R^2s obtained by regressing each independent variable on all others are very close to 1 (R^2 around .930). Multicollinearity problems make it impossible to separate and distinguish the effect of the independent variables on the dependent variable.

In order to solve the collinearity problem, we use a procedure proposed by Smith and Sasaki (1979) which consists of subtracting the mean from each component variable in the interaction term. For example, the mean of the variable *control* is .321 and the mean of the variable *influence* is 12.442. The corrected interaction term composed of these two variables is (control - .321) * (influence - 12.442). A similar transformation is applied to every interaction term.

Table 5.3 presents the correlation and the R^2 coefficients of the independent variables and of the corrected interaction terms.

Table 5.3
Main Variables and Corrected Interaction Terms' Correlation and R^2 Coefficients
(Overall Sample)

Variable	1	2	3	4	5	6	7	8	9	R^2
1.Control	1.000									.072*
2.Coordination	-.158*	1.000								.067*
3.Efficiency	-.076	.061	1.000							.095**
4.Access	-.156*	.162*	.243*	1.000						.087**
5.Influence	-.069*	.003	.026	-.079	1.000					.031
6.Control * Influence	-.087	.002	-.274***	-.026	.073	1.000				.109**
7.Coordination * Influence	.000	.238***	.005	-.007	.021	-.172*	1.000			.095**
8.Efficiency * Influence	-.257**	.004	.093	-.091	.104	.161*	-.068	1.000		.120***
9.Access * Influence	-.030	-.005	-.111	-.145*	.102	-.153*	.122	.207**	1.000	.078*

* P<.05
** P<.01
*** P<.001

Table 5.3 indicates that the collinearity problems are solved by the transformations. The correlations are much smaller than the .80 norm and the

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R^2s are also well below the 1 norm. Smith and Sasaki (1979) suggest that it is particularly important to perform a residual analysis when using interaction terms to search for evidence that the assumptions underlying regression analysis are violated. The results of the residual analysis are presented in Appendix H. They indicate that all the fundamental assumptions of regression analysis are met.

Regression Analysis

Now that we have reliable independent variables we can perform the regression analysis. Recall that we use a regression approach which entails a hierarchy of three regressions that, for clarity, is repeated here. The dependent variable (*ratiomm*) is regressed on:

(1) control, coordination, efficiency, access, and logemp,

(2) control, coordination, efficiency, access, influence, and logemp, and

(3) control, coordination, efficiency, access, influence, (control * influence), (coordination * influence), (efficiency * influence), (access * influence), and logemp.

Table 5.4 presents the results of the regressions. It shows the unstandardized and standardized coefficients and the T-Test value and its significance for each variable in the three regressions. Table 5.4 also contains the coefficient of determination (R^2) for each regression, its F-Test value, and its significance.

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Table 5.4
Hierarchy of Regressions with Corrected Interaction Terms
(Overall sample)

Variable in the equation	R^2	F	Unstandardized coefficient (B)	Standardized coefficient (BETA)	T
Regression 1	.147	5.085***			
Control			.359	.208	2.604*
Coordination			1.491	.108	1.363
Efficiency			-.124	-.021	-.262
Access			.446	.181	2.140*
Logemp			.059	.351	4.144***
(Constant)			.174		1.351
Regression 2	.150	4.333***			
Control			.349	.202	2.517*
Coordination			1.535	.111	1.400
Efficiency			-.113	-.019	-.237
Access			.425	.173	2.022*
Influence			-.003	-.061	-.796
Logemp			.058	.345	4.063***
(Constant)			.221		1.560
Regression 3	.193	3.427***			
Control			.343	.198	2.414*
Coordination			2.245	.163	2.001**
Efficiency			.054	.009	.107
Access			.378	.154	1.791
Influence			-.003	-.066	-.863
(Control - .321) * (Influence - 12.442)			.031	.067	.796
(Coordination - .008) * (Influence - 12.442)			-.796	-.198	-2.487*
(Efficiency - .037) * (Influence - 12.442)			-.085	-.056	-.677
(Access - .078) * (Influence - 12.442)			.040	.052	.646
Logemp			.055	.326	3.866***
(Constant)			.244		1.734

* P<.05
** P<.01
*** P<.001

The transformations to the interaction terms do not change the nature of the overall regression but only the relative importance of each independent variable. The R^2, its F-Test value, and its significance level are unaffected. By eliminating collinearity problems, the transformations partition the total effect of all the variables in the equations so it reflects the "real" effect of each variable.

Recall that in a hierarchical analysis, we are not as much interested in the first two regressions as in the final regression containing the interaction terms and in the change in the R^2 from the second to the third regression. Three observations can be made based on Table 5.4. First, hypothesis 3 is supported.

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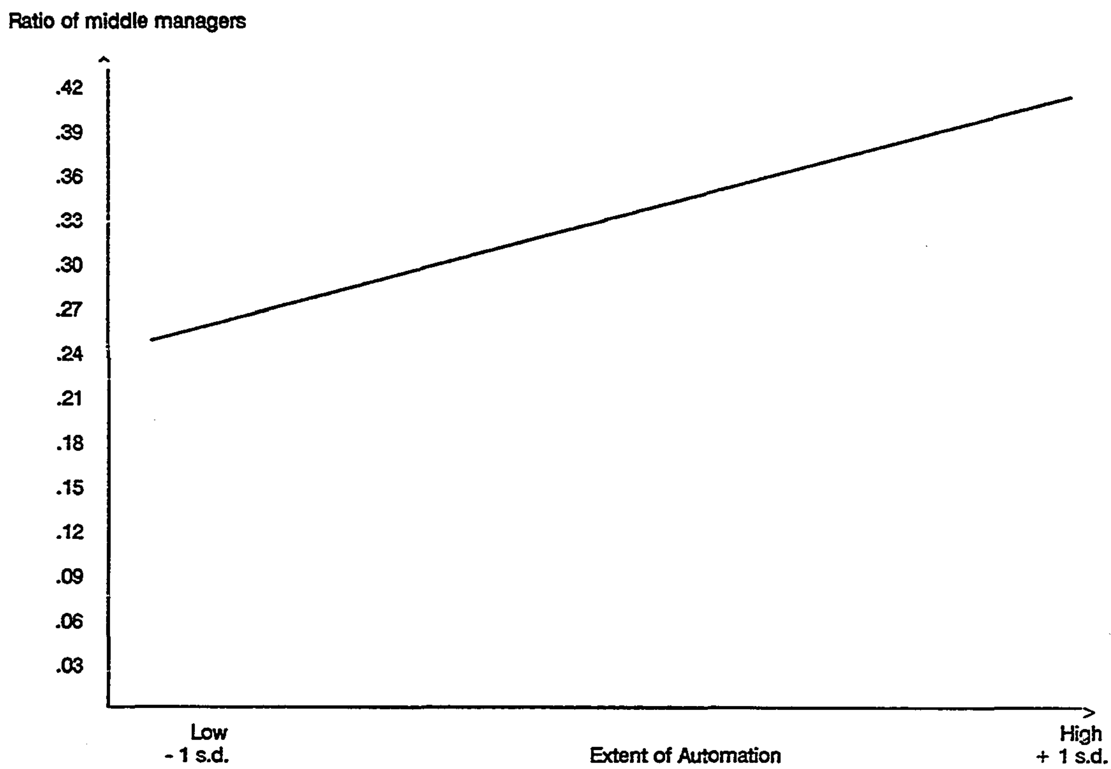
Recall that hypothesis 3 predicted that the increase in the middle management workforce is more pronounced than the decrease in the middle management workforce and that therefore, overall, IT increases the ratio of middle managers. Regression 1 indicates that the effect of IT on the ratio of middle managers for the aggregated sample is positive. We can calculate the regression equation and plot the regression line by substituting values of one standard deviation above the mean and of one standard deviation below the mean for the IT variables to represent high and low levels of extent of automation. Figure 5.1 illustrates the relationship between IT and the ratio of middle managers for the overall sample.

Figure 5.1
A Graphic Illustration and the Regression Equations for the Main Effects of IT on the Ratio of Middle Managers (Overall sample)



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Ratiomm	= .359 Control + 1.491 Coordination - .124 Efficiency + .446 Access + .174
Low IT	= Mean - 1 standard deviation
Ratiomm	= .359 (.321 - .100) + 1.491 (.008 - .013) - .124 (.037 - .029) + .446 (.078 - .070) + .174
	= .248
High IT	= Mean + 1 standard deviation
Ratiomm	= .359 (.321 + .100) + 1.491 (.008 + .013) - .124 (.037 + .029) + .446 (.078 + .070) + .174
	= .415

The relatively steep positive slope of the regression line clearly indicates that the relationship between IT and the ratio of middle managers is positive. The higher the extent of automation, the more middle managers there are (controlling for size). The data of Figure 5.1 do not preclude the reverse relationship. That is, the higher the number of middle managers, the higher the extent of automation. However, as will be seen in Figure 5.2 and later, this reverse relationship does not hold true in this study.

The second observation is that the final model (regression 3) explains 20% of the variance in the ratio of middle managers, which is statistically significant at P<.001. Third, the difference between the R^2 of the third model (.193) and the R^2 of the second model (.150) is not statistically significant.

F test = [(.193-.150)/(1-.193)] * [(155-6-4-1)/4]

F test = 1.92 $\quad F_{4, 144\ (.05)} = 2.43$

However, and more important, we note that the interaction between the structure of computing decision and IT has substantive importance when the unstandardized regression equations for organizations with centralized computing decision and for organizations with decentralized computing decision are calculated and plotted.

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We use the following procedure to calculate the regression equations. First, the regression equation is broken down to express each IT coefficient in terms of the influence variable.

$$Y = b_1x_1 + b_2x_2 + b_3x_1x_2 + A$$

Ratiomm = .343 control + .031 (control * influence) + 2.245 coordination - .796 (coordination * influence) + .054 efficiency - .085 (efficiency * influence) + .378 access + .040 (access * influence) - .003 influence + .244

= (.343 + .031 influence) control + (2.245 - .796 influence) coordination + (.054 - .085 influence) efficiency + (.378 + .040 influence) access + (.244 - .003 influence)

Then, to examine further the effect of the independent variables on the dependent variable, the values of one standard deviation above the mean and of one standard deviation below the mean of the moderator variable are substituted into the equation. This generates two equations: one for organizations with centralized computing decision and one for organizations with decentralized computing decision.

Centralized computing authority = mean influence + 1 standard deviation

= 12.442 + 3.526

= 15.968

Ratiomm = .838 control - 10.466 coordination - 1.303 efficiency + 1.107 access + .196

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Decentralized computing authority = mean influence - 1 standard deviation

= 12.442 - 3.526

= 8.896

Ratiomm = .619 control - 4.852 coordination - .704 efficiency + .735 access + .217

Finally, the IT coefficients are replaced in each equation by the values of one standard deviation above their mean and of one standard deviation below their mean to represent high and low extent of automation.

Centralized computing authority

Low IT = mean - 1 standard deviation

Ratiomm = .838 (.321 - .100) - 10.466 (.008 - .013) - 1.303 (.037 - .029) + 1.107 (.078 - .070) + .196

= .426

High IT = mean + 1 standard deviation

Ratiomm = .838 (.321 + .100) - 10.466 (.008 + .013) - 1.303 (.037 + .029) + 1.107 (.078 + .070) + .196

= .394

Decentralized computing authority

Low IT = mean - 1 standard deviation

Ratiomm = 619 (.321 - .100) - 4.852 (.008 - .013) - .704 (.037 - .029) + .735 (.078 - .070) + .217.

= .375

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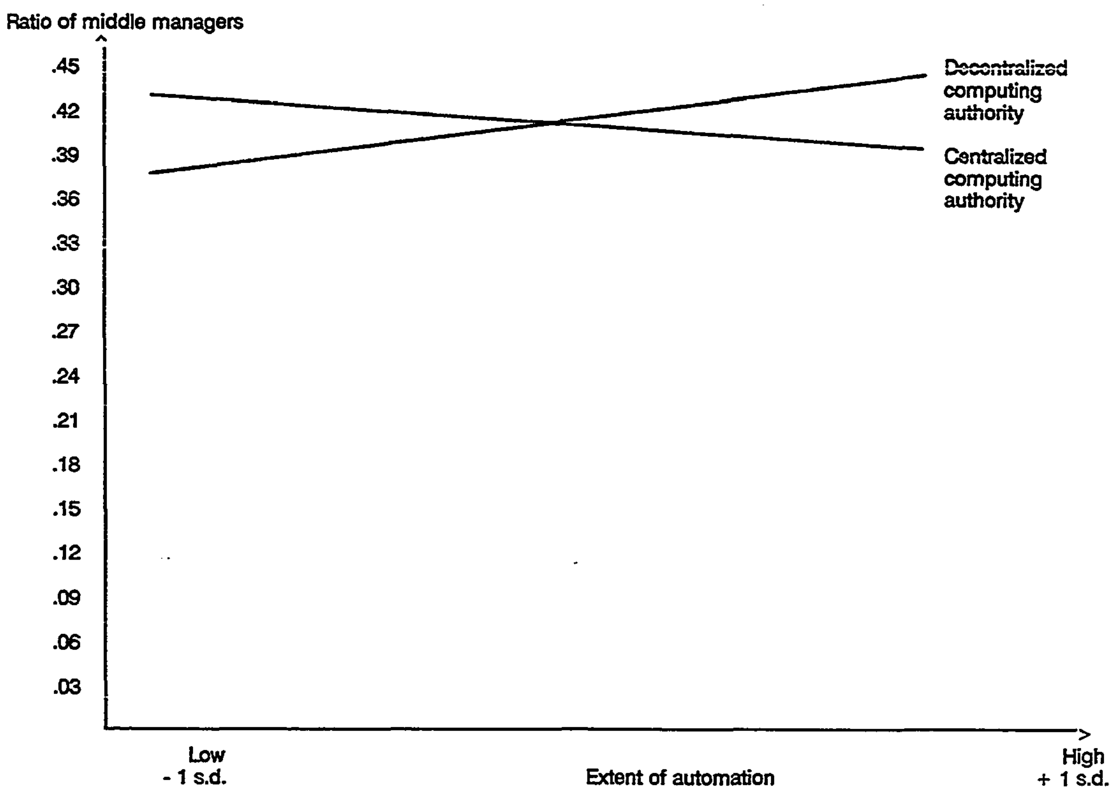
High IT = mean + 1 standard deviation

$$\text{Ratiomm} = .619\ (.321 + .100) - 4.852\ (.008 + .013) - .704\ (.037 + .029)$$
$$+ .735\ (.078 + .070) + .217$$
$$= .438$$

The two regression equations are then plotted to illustrate the relationship between the extent of automation and the ratio of middle managers at different levels of automation. There is one regression line for organizations with centralized computing decision and one for organizations with decentralized computing decision.

Figure 5.2
A Graphic Illustration of the Regression Equations for Organizations with Centralized and Decentralized Computing Authority
(Overall sample)



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Three observations can be made based on the regression equations and on Figure 5.2. First, Figure 5.2 indicates that the overall positive relationship illustrated in Figure 5.1 hides two opposing relationships between IT and the number of middle managers. The extent of automation increases the ratio of middle managers (positive slope) in organizations with decentralized computing authority. On the other hand, the extent of automation decreases the ratio of middle managers in organizations with centralized computing authority. This observation refutes the reverse relationship discussed above, the proposition that it is the number of middle managers that determines the extent of automation. Figure 5.2 is based on the same sample with the same number of middle managers as Figure 5.1. Therefore, if the reverse relationship were true, the same results would be obtained and the structure of computing authority would not have a significant moderating effect on the IT-middle management relationship. However, Figure 5.2 clearly indicates that the structure of computing authority does moderate this relationship substantially. Second, the disordinal interaction (the two regression lines crossing one another) of Figure 5.2 indicates substantive significance. Third, the regression equations presented earlier indicate that the coordination information systems and the efficiency information systems have a negative impact on the ratio of middle managers that is two times as large in organizations with centralized computing authority as in organizations with decentralized computing authority (10.466 vs -4.852 and -1.303 vs -.704).

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These observations indicate that the structure of computing decision authority affects the IT-middle management relationship even when the structure of organizational decision authority is not taken into account. This provides a first support for the conceptual framework presented in Chapter 3, which precisely stipulates that the structure of computing decision authority is the fundamental determinant of the IT impact.

Analysis of the Two Sub-Samples

Now that we have performed the regression analysis for the overall sample, the sample can be split in centralized and decentralized organizations and the analysis can be done again. Recall that the theory-driven method is favored for grouping the organizations. Organizations with an average score at or above assistant manager on the measure of the structure of organizational decision are classified as centralized, and organizations with an average score at department heads or below are classified as decentralized.

Collinearity analysis

Before performing the regression analysis, we need to test for collinearity problems in each sub-sample. Table 5.5 presents the correlation and the R^2 coefficients for the independent variables and the uncorrected interaction terms for centralized and decentralized organizations. The correlation coefficients for centralized organizations can be found below the diagonal, and the correlation

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coefficients for decentralized organizations can be found above the diagonal. Table 5.5 indicates that there is a problem of multicollinearity in the two sub-samples. All the component variables are very highly correlated with their interaction terms and the variance of every independent variables is almost totally explained by the other independent variables in both sub-samples (R^2 around .950).

Table 5.5
Main Variables and Interaction Terms' Correlation and R^2 Coefficients
(Centralized organizations below the diagonal, decentralized above)

Variable	1	2	3	4	5	6	7	8	9	R^2 (cent.)	R^2 (decent.)
1.Control	1.000	-.254*	-.035	-.148	-.317**	.564***	-.296**	-.212*	-.221*	.940***	.931***
2.Coordination	-.082	1.000	.041	.196	.012	-.205*	.957***	.037	.196	.938***	.947***
3.Efficiency	-.108	.073	1.000	.175	-.010	-.122	.037	.845***	.145	.940***	.934***
4.Access	-.172	.126	.306**	1.000	-.094	-.185	.170	.091	.904***	.957***	.935***
5.Influence	.114	.053	.071	-.049	1.000	.566***	.163	.468***	.258*	.951***	.945***
6.Control * Influen.	-.773***	-.026	-.070	-.167	.691***	1.000	-.140	.148	.029	.969***	.952***
7.Coordi. * Influen.	.055	.962***	.077	.101	.219*	.095	1.000	.094	.232*	.942***	.947***
8.Effici. * Influen.	-.114	.085	.946*	.234*	.299**	.069	.130	1.000	.232*	.943***	.942***
9.Access * Influen.	-.144	.137	.281**	.927***	.269**	.041	.175	.298**	1.000	.961***	.939***

* P<.05
** P<.01
*** P<.001

Here again the collinearity problem is corrected by subtracting the mean from each component variable of the interaction terms. Table 5.6 indicates that the procedure solves the collinearity problems in both sub-samples.

Table 5.6
Main Variables and Corrected Interaction Terms' Correlation and R^2 Coefficients
(Centralized organizations below the diagonal, decentralized above)

Variable	1	2	3	4	5	6	7	8	9	R^2 (cent.)	R^2 (decent.)
1.Control	1.000	-.254*	-.035	-.148	-.317**	-.167	.023	-.278*	.055	.067	.125
2.Coordination	-.082	1.000	.041	.196	.012	.010	.022	-.001	.003	.164**	.092
3.Efficiency	-.108	.073	1.000	.175	-.010	-.317**	.000	.135	-.090	.109	.182**
4.Access	-.172	.126	.306**	1.000	-.094	.047	.006	-.068	-.182	.058	.117
5.Influence	.114	.053	.071	-.049	1.000	.272*	-.149	-.520***	-.246*	.119	.154*
6.Control * Influen.	-.023	-.012	-.207*	-.076	.144	1.000	-.435***	.203*	-.185	.099	.178*
7.Coordi. * Influen.	-.011	.408***	.012	.005	.072	-.002	1.000	-.241*	.088	.196**	.137
8.Effici. * Influen.	-.213*	.013	.080	-.123	-.283**	.047	.051	1.000	.096	.082	.248
9.Access * Influen.	-.094	.007	-.146	.025	-.059	-.194*	.180*	.231*	1.000	.073	.092

* P<.05
** P<.01
*** P<.001

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All correlation and R^2 coefficients are brought by the transformations well below the collinearity norms of $r > .80$ and R^2 close to 1.

Regression Analysis

Now that the multicollinearity problem is solved, we can perform the hierarchical regression analysis for the centralized and decentralized organizations. Table 5.7 presents the results of this analysis.

Table 5.7
Hierarchy of Regressions with Corrected Interaction Terms
(Centralized and decentralized organizations)

	Centralized organizations					Decentralized organizations				
Variable in the equation	R^2	F	Unstd. (B)	Std. (BETA)	T	R^2	F	Unstd. (B)	Std. (BETA)	T
Regression 1	.140	2.605*				.184	2.804*			
Control			.371	.202	1.835			.322	.206	1.713
Coordination			.746	.118	1.110			.972	.078	.636
Efficiency			-.431	-.068	-.605			-.036	.007	-.057
Access			.512	.163	1.416			.427	.226	1.715
Logemp			.052	.321	2.733**			.076	.424	3.280**
(Constant)			.205		1.130			.094		.492
Regression 2	.152	2.356*				.185	2.314*			
Control			.391	.213	1.927			.340	.218	1.690
Coordination			1.869	.126	1.185			.988	.080	.641
Efficiency			-.372	.059	-.521			-.037	-.007	-.058
Access			.483	.154	1.331			.437	.231	1.723
Influence			-.006	-.110	-1.045			.002	.033	.269
Logemp			.051	.313	2.665**			.076	.426	3.265**
(Constant)			.278		1.429			.066		.304
Regression 3	.214	2.045*				.307	2.525*			
Control			.314	.172	1.529			.359	.230	1.822
Coordination			2.838	.192	1.642			1.109	.089	.752
Efficiency			-.030	-.005	-.040			.072	.013	.106
Access			.269	.086	.729			.421	.222	1.723
Influence			-.008	-.165	-1.506			-.003	-.075	-.526
(Control * Influence)[1]			.021	.039	.362			.039	.093	.654
(Coordination * Influence)[1]			-.579	-.138	-1.186			-1.120	-.288	-2.277*
(Efficiency * Influence)[1]			-.469	-.244	-2.112*			.099	.078	.577
(Access * Influence)[1]			.108	.095	.835			.004	.007	.054
Logemp			.048	.296	2.483*			.077	.429	3.426**
(Constant)			.359		1.809			.177		.542

* P<.05 ** P<.01 *** P<.001

1. The corrected interaction terms for centralized organizations are: (control - .320) * (influence - 12.733), (coordination - .008)
* (influence - 12.733), (efficiency - .034) * (influence - 12.733), and (access - .072) * (influence - 12.733).

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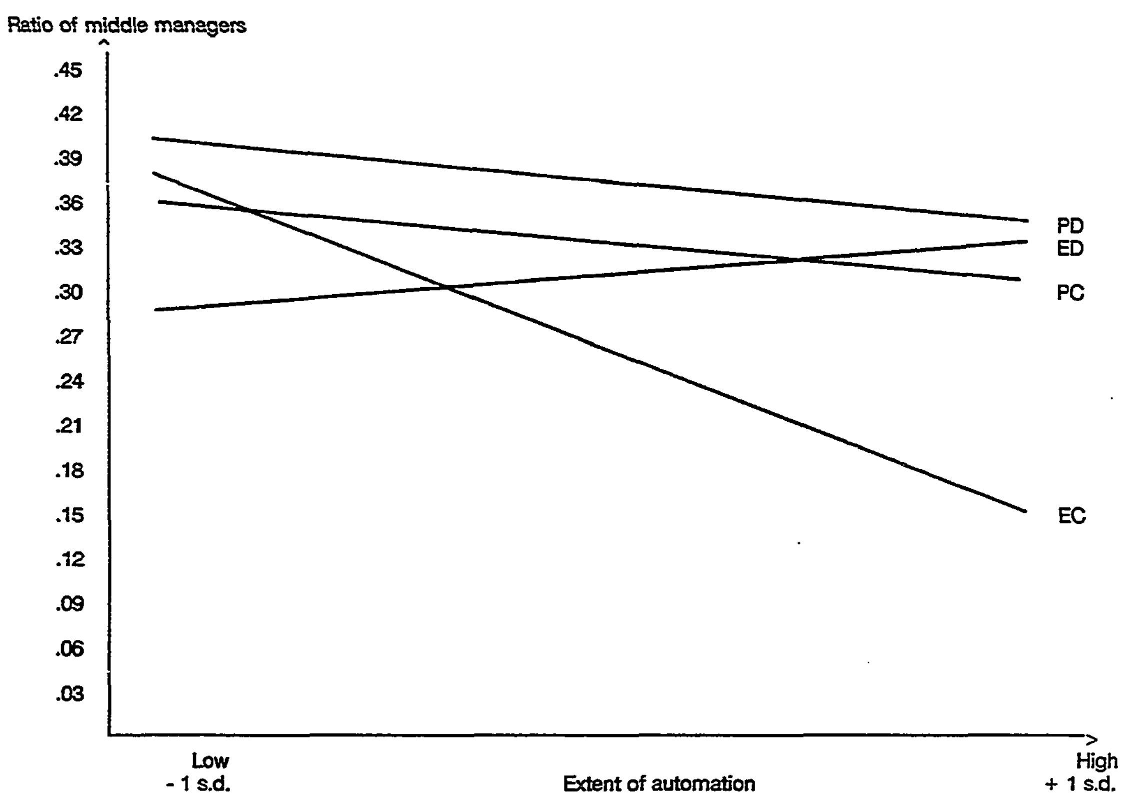
The corrected interaction terms for decentralized organizations are: (control - .321) * (influence - 12.074), (coordination - .009) * (influence - 12.074), (efficiency - .041) * (influence - 12.074), and (access - .086) * (influence - 12.074).

The regression equations using standardized coefficients are:

Extensive centralization:	.809 control - 2.065 coordination - 3.996 efficiency + 1.639 access
Partial decentralization:	.527 control - 1.065 coordination - 2.228 efficiency + .952 access
Partial centralization:	1.668 control - 4.365 coordination - 1.219 efficiency + .330 access
Extensive decentralization:	1.038 control - 2.412 coordination + .690 efficiency + .283 access

The effect of the extent of automation can be analyzed further by plotting the four regression lines. Recall that the lines are plotted by substituting the values of one standard deviation above the mean and of one standard deviation below the mean of all IT indexes to represent high and low extent of automation. The regression equations and the regression lines are presented in Figure 5.3.

Figure 5.3
A Graphic Illustration and the Regression Equations for the Four Types of Organizations



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EC: Extensive centralization PC: Partial centralization
ED: Extensive decentralization PD: Partial decentralization

Centralized structure of organizational decision making authority

Ratiomm = .314 control + .021 control * influence + 2.838 coordination - .579 coordination * influence - .030 efficiency - .469 efficiency * influence + .269 access + .108 access * influence + .359
= (.314 + .021 influence)(control) + (2.838 - .579 influence)(coordination) + (- .030 - .469 influence)(efficiency) + (.269 + .108 influence)(access) + (.359 - .008 influence)

<u>Extensive centralization</u> (centralized computing authority) = influence = mean + 1 standard deviation
= 12.733 + 3.622
= 16.355

Ratiomm = .657 control - 6.632 coordination - 7.700 efficiency + 2.035 access + .228
Low IT = mean - 1 standard deviation
Ratiomm = .657(.320 - .101) - 6.632(.008 - .012) - 7.700(.034 -.029) + 2.035 (.072 - .059) + .228
= .386
High IT = mean + 1 standard deviation
Ratiomm = .657(.320 + .101) - 6.632(.008 + .012) - 7.700(.034 + .029) + 2.035(.072 + .059) + .228
= .153

<u>Partial decentralization</u> (decentralized computing authority) = influence = mean - 1 standard deviation
= 12.733 - 3.622
= 9.111

Ratiomm = .505 control - 2.437 coordination - 4.303 efficiency + 1.253 access + .286
Low IT = mean - 1 standard deviation
Ratiomm = .505(.320 -.101) - 2.437(.008 -.012) - 4.303(.034 -.029) + 1.253(.072 -.059) + .286
= .401
High IT = mean + 1 standard deviation
Ratiomm = .505(.320 + .101) - 2.437(.008 + .012) - 4.303(.034 +.029) + 1.253(.072 + .059) + .286
= .343

Decentralized structure of organizational decision making authority

Ratiomm = .359 control + .039 control * influence + 1.109 coordination - 1.121 coordination * influence + .072 efficiency + .099 efficiency * influence + .421 access + .004 access * influence - .003 + .117
= (.359 + .039 influence)(control) + (1.109 - 1.121 influence)(coordination) + (.072 + .099 influence)(efficiency) + (.421 + .004 influence)(access) + (.117 - .003 influence)

<u>Partial centralization</u> (centralized computing authority) = influence = mean + 1 standard deviation
= 12.074 + 3.391
= 15.465

Ratiomm = .962 control - 16.227 coordination + 1.603 efficiency + .483 access + .071
Low IT = mean - 1 standard deviation
Ratiomm = .962(.321 - .100) - 16.227(.009 - .013) + 1.603(.041 -.029) + .483(.086 - .083) + .071
= .369
High IT = mean + 1 standard deviation
Ratiomm = .962(.321 + .100) - 16.227(.009 + .013) + 1.603(.041 + .029) + .483(.086 + .083) + .071
= .313

<u>Extensive decentralization</u> (decentralized computing authority) = influence = mean - 1 standard deviation
= 12.074 - 3.391
= 8.683

Ratiomm = .698 control - 8.625 coordination + .932 efficiency + .456 access + .091
Low IT = mean - 1 standard deviation
Ratiomm = .698(.321 -.100) - 8.625(.009 -.013) + .932(.041 -.029) + .456(.086 -.083) + .091
= .292
High IT = mean + 1 standard deviation
Ratiomm = .698(.321 + .100) - 8.625(.009 + .013) + .932(.041 +.029) + .456(.086 + .083) + .091
= .337

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Hypotheses. The findings presented in Table 5.7 and graphed in Figure 5.3 are discussed with regard to the three hypotheses drawn from the framework. Recall that the fourth hypothesis has already been discussed in the analysis of the overall sample. The remaining four hypotheses are restated for clarity:

Hypothesis 1:
The more centralized the decision authority, the more the extent of automation will reduce the ratio of middle managers.

Recall from the framework of Table 3.1 that the concentration of decision authority is determined by the concentration of the computing authority and of the organizational authority. Therefore, if hypothesis 1 is true, the following propositions are expected:

Proposition a:
When the structure of computing authority is centralized and the structure of organizational authority is centralized (extensive centralization), the extent of automation decreases the middle management workforce.

Proposition b:
When the structure of computing authority is decentralized and the structure of organizational authority is decentralized (extensive decentralization), the extent of automation decreases the middle management workforce.

Proposition c:
When the structure of computing authority is centralized and the structure of organizational authority is decentralized (partial centralization), the extent of automation decreases the middle management workforce.

Proposition d:
When the structure of computing authority is decentralized and the structure of organizational authority is centralized (partial decentralization), the extent of automation increases the middle management workforce.

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Proposition e:

The impact of the extent of automation is more pronounced in the extensive situations than in the partial situations.

Hypothesis 2a:

Top managers use the control and the efficiency applications to reduce the middle management workforce.

Hypothesis 2b:

Middle managers use the control and the coordination applications to increase the middle management workforce.

Hypothesis 3

The increase in the middle management workforce in decentralized organizations is more pronounced than the decrease in the middle management workforce in centralized organizations.

Hypothesis 1 can be tested through the five propositions. The data of Figure 5.3 *support hypothesis 1*. The regression line for organizations with an extensive centralization structure presented in Figure 5.3 *supports proposition a*. It indicates that IT has a negative impact on the ratio of middle managers. The greater the extent of automation in those cities, the lower the ratio of middle managers. Figure 5.3 also *supports proposition b*. It indicates that increases in the extent of automation lead to increases in the ratio of middle managers in organizations with an extensive decentralization structure. The data of Table 5.7 and Figure 5.3 also *support proposition c*. Figure 5.3 indicates that the impact of the extent of automation on the ratio of middle managers is negative in organizations with a partial centralization structure. The greater the extent of authority the lower the ratio of middle managers. The findings *do not support proposition d*. Figure 5.3 indicates that the extent of automation decreases the ratio of middle managers slightly rather than increasing it slightly in organizations

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with a partial decentralization structure. Finally, *proposition e is supported.* Figure 5.3 clearly indicates that the effect of the extent of automation is stronger in the extensive centralization than in the partial centralization situation. The relationship between the extensive decentralization and the partial decentralization situations is inconclusive.

The findings provide *partial support to hypothesis 2a* that top managers use the control and efficiency applications to reduce the ratio of middle managers. The regression equations representing extensive centralization using standardized coefficients presented in Table 5.7 indicate that the efficiency applications are in fact the most important determinant the IT impact (standardized coefficient = -3.996). The impact of the efficiency applications is two times as important as that of the coordination and access variables (-2.065, 1.639), and five times stronger than that of the control applications (.809). However, the findings also indicate that the control applications are not used by top managers. In fact, contrary to the hypothesis, they are the least influential applications. It is the coordination applications that are the second most important determinant of the IT impact.

Finally, the data *support hypothesis 2b* that middle managers use the control and coordination applications to increase the middle management workforce. The regression equations of the extensive decentralization using the standardized coefficients indicate that the coordination and the control applications are used by middle managers and that they have the strongest impact on the ratio of middle managers. The importance of the coordination application

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is two times that of the control applications (standardized coefficients of - 2.412 and 1.038 respectively), three times that of the efficiency applications (.690), and almost nine times that of the access variable (.283). The control applications are almost two times as important as the efficiency application, and almost four times the access variable.

However, the impact of the coordination applications is negative, not positive as expected. This indicates that the middle managers use the coordination application to take over some routine horizontal communication activities and create free time, and that they use the control applications to gain more authority and importance, and thus increase their number. The positive effect of the control, efficiency, and access variables outweighs the negative effect of the coordination variable.

Other observations. Five additional observations can be made based on Table 5.7 and Figure 5.3. First, using the structure of organizational decision alone as a moderator variable does not add significantly to the proportion of variance explained in the ratio of middle managers. This can be determined by the difference in the R^2 of regression 1 for the overall sample and the R^2 of regressions 1 for the two sub-samples: $R^2_{1\ \mathrm{overall}} = .15$; $R^2_{1\ \mathrm{centralized}} = .14$; and $R^2_{1\ \mathrm{decentralized}} = .18$. The coefficient of determination actually decreases by 1 (7%) in the centralized organizations sample and increases by 3 (20%) in the decentralized organizations sample.

The second observation is that the coefficient of determination increases substantially when both the structure of organizational decision and the structure

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of computing decision are used as moderator variables. This can be determined by comparing the R^2 of regression 3 for the centralized and the decentralized organizations (where both moderator variables are used) to the R^2 of regression 2 for the overall sample (where no moderator variable is used): $R^2_{2\ \text{overall}} = .15$; $R^2_{3\ \text{centralized}} = .21$; and $R^2_{3\ \text{decentralized}} = .31$. The coefficient of determination increases by 6 (40%) in the centralized organizations sample and by 16 (107%) in the decentralized organizations sample. Although there is no test to determine the statistical significance of the changes in R^2, the increases appear substantial and significant.

These two observations support the framework presented in Chapter 3. They indicate that the most significant gain in the coefficient of determination is obtained by using both moderator variables together. This is precisely what the conceptual framework stipulates. A more complete understanding of the impact of IT on middle managers can only be obtained by seeing the structure of organizational decision and the structure of computing as complementary to each other.

The third observation is that the relative importance of the indexes of IT basically depends on the roles of middle managers. The regression equations based on the standardized coefficients presented in Table 5.7 indicate that the efficiency applications are the most important determinant of the IT impact in organizations with a centralized structure of organizational decision, that is, where the roles of middle managers are mostly structured decisional and informational. (The standardized coefficient = -3.996 in extensive centralization and -2.228 in

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partial decentralization.) The second most important determinant is the coordination applications (-2.065 in extensive centralization and -1.065 in partial decentralization), followed by the access variable (1.639 in extensive centralization and .952 in partial decentralization), and lastly, by the control applications (.809 in extensive centralization and .527 in partial decentralization). The impact of the efficiency applications is two times that of the coordination applications, three times that of the access variable, and six times that of the control applications. The coordination applications have an impact almost two times stronger than that of the access variable and almost four times that of the control applications. The access variable is two times as important as the control variable.

On the other hand, it is the coordination applications that have the strongest impact in organizations with a decentralized structure of organizational decision, that is, where the roles of middle managers are mostly unstructured decisional. (The standardized coefficient = -2.412 in extensive decentralization and -4.365 in partial centralization.) They are followed by the control applications (1.038 in extensive decentralization and 1.668 in partial centralization), the efficiency applications (.690 in extensive decentralization and -1.219 in partial centralization), and lastly, by the access variable (.283 in extensive decentralization and .330 in partial centralization). The standardized coefficients also indicate that the impact of the coordination applications is four times stronger than those of the control and efficiency applications, and forty times stronger than that of the access variable. The control and the efficiency

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applications have a similar impact, which is about twelve times stronger than that of the access variable.

The fourth observation is that the importance of the impact of some variables also depends on the structure of computing decision. The four unstandardized regression equations presented in Figure 5.3 are quite indicative of that. The coordination applications have a negative effect in all four situations, but their magnitude varies greatly. Their impact is two to three times stronger in organizations where computing authority is centralized than where it is decentralized (- 6.632 in extensive centralization vs - 2.437 in partial decentralization; - 16.227 in partial centralization vs - 8.625 in extensive decentralization). The impact of the efficiency applications is two times as strong in organizations where computing decision is centralized as where it is decentralized (-7.7 in extensive centralization vs -4.303 in partial decentralization; 1.603 in partial centralization vs .932 in extensive decentralization). Finally, the access variable and the control applications have a relatively constant positive impact whether the structure of computing decision authority is centralized or decentralized.

The fifth and final observation is that the fundamental premise of this study that the structure of organizational decision and the structure of computing decision interact together and either facilitate or counter each other's impact is supported. The extent of automation strongly decreases the ratio of middle managers in organizations with an extensive centralization structure, that is where both structures of decision authority foster such a reduction. On the other hand,

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the extent of automation increases the ratio of middle managers in organizations with an extensive decentralization structure, that is where both structures of decision authority foster such an impact. The effect of the extent of automation is similar in the two partial situations (i.e. the slopes of the two regression lines of Figure 5.3 are the same). This indicates that the two structures of decision authority counter each other's moderating effects on the IT impact. The impact of the extent of automation is similar in organizations where top managers control computing and the roles of middle managers are not easily amenable to computerization (partial centralization) tho the impact in organizations where it is middle managers who control computing and their roles are easily amenable to computerization (partial decentralization).

Conclusion: Summary of the Survey Findings

In summary, the findings of the survey analysis support hypotheses 1, 2b, and 3, and partially support hypothesis 2a. It was found that the more centralized the decision authority, the more the extent of automation reduces the ratio of middle managers (hypothesis 1 supported).

It was found that top managers use the efficiency applications and the coordination applications to reduce the middle management workforce, but not the control applications, as hypothesis 2a contended.

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Also, it was found that middle managers use the control and the coordination applications to increase the middle management workforce, as hypothesis 2b contended.

Finally, hypothesis 3 is also supported. It was found that the increase in the middle management workforce is more pronounced than the decrease in the middle management workforce.

The survey findings also indicate that the relative importance of the individual variables depend on the structure of organization decision and on the structure of computing decision. The findings support the framework presented in Chapter 3. The greatest knowledge gain is obtained when the two structures of decision authority are seen as complementary to each other. The structure of organizational decision and the structure of computing decision interact and moderate the impact of IT on the ratio of middle managers.

The next chapter presents the findings of the case analysis regarding the impact of IT on the occupation profile of middle manager and on the roles of middle managers in organizations with an extensive centralization structure. It also discusses what the findings mean for hypothesis 1. It concludes by bringing together the findings of the survey and of the case study and by discussing what they mean for the conceptual framework presented in Chapter 3.

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Chapter VI

Findings of the Case Study Analysis

This chapter presents the case study analysis. It presents the findings regarding the impact of the extent of automation on the number and on the roles of middle managers in turn. It also discusses what the findings mean for hypothesis 1. The chapter concludes by bringing together the survey findings and the case study findings, and by discussing what they mean for the conceptual framework presented in Chapter 3.

Middle Management Workforce

City A

Table 6.1 presents the extent to which the control, coordination, and efficiency applications are automated and the number of access points in each department and for the organization as a whole. Table 6.1 also presents the evolution of the number of employees and of the number of middle managers in each department of City A from 1984 to 1989.

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Table 6.1
Information Technology and Employment: City A

Department	Information Technology				Employment: Employees / % change					Employment: Middle managers / % change				
	Control	Coord.	Effi	Access	1984	1985	1986	1987	1988	1984	1985	1986	1987	1988
Public related														
Community Services	4/7 57%	0/5 0%	2/8 25%	12 4.5	46	50 9%	53 6%	51 (4%)	54 6%	8	16 100%	15 (6%)	15 0%	16 7%
Public Safety	18/29 62%	3/5 60%	7/8 88%	32 5.5	150	165 10%	165 0%	167 1%	177 6%	16	18 13%	13 (7%)	12 (8%)	12 0%
Public Works	16/25 64%	3/5 60%	7/8 88%	28 3.6	78	101 29%	102 1%	95 (7%)	102 7%	10	12 20%	13 8%	15 15%	16 7%
Public Services	5/8 63%	3/5 60%	7/8 88%	40 3.0	99	113 14%	114 1%	110 (4%)	120 9%	12	14 17%	12 (14%)	11 (8%)	10 (9%)
Internal														
General Gov. and Admin. Services	32/38 84%	3/5 60%	7/8 88%	70 1.2	74	80 8%	81 1%	75 (7%)	81 8%	20	18 (10%)	19 6%	15 (21%)	19 27%
Community development	1/2 50%	3/5 60%	7/8 88%	18 4.3	61	80 31%	81 1%	74 (9%)	77 4%	10	14 40%	15 7%	15 0%	15 0%
Total	76/111 68%	15/30 50%	37/48 77%	200 3.1	508	589 16%	596 1%	572 (4%)	611 7%	76	92 21%	87 (5%)	83 (5%)	88 6%

Legend

For clarity, only the first civic year is used to refer to a fiscal year. 1983 refers to the fiscal year 1983-1984; 1984 refers to the fiscal year 1984-1985, and so on.

The coordination and efficiency applications are organization-wide information systems. Numerators indicate the number of applications in operations in a particular department, and denominators indicate the number of applications in operations in the organization.

The top numbers or the access variable indicate how many access points there are in the department, and the lower numbers indicate that there is one access point for every x employees (1988).

Table 6.2 presents the revenues, expenditures and DP budget of City A from 1983 to 1989.

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Table 6.2
Revenues, Expenditures, and DP budget: City A

(000$ / % change)

	1983	1984	1985	1986	1987	1988
Revenues	28,862 27%	36,799 8%	39,698 11%	44,178 10%	48,626 15%	55,709
Expenditures	21,919	27,068 23%	33,999 26%	37,108 9%	39,615 7%	45,660 15%
Net Revenues	6,943 40%	9,731 (41%)	5,699 24%	7,070 27%	9,011 12%	10,049
DP Budget	491 32%	650 57%	1,018 4%	1,057 6%	1,123 7%	1,204

The data presented in Tables 6.1 and 6.2 were obtained by interviewing the director and two middle managers in each department, the director of personnel, and the DP manager. Job descriptions of the interviewees and of some other middle managers, annual budgets from 1983 to 1989, and detailed organization charts were used to supplement the interviews.

Two observations can be made based on Tables 6.1 and 6.2 before actually discussing the IT impacts. First, the trend in revenues and expenditures directly affects the employment level. Table 6.2 indicates that the revenues and expenditures in 1983 and 1984 are growing quite rapidly. In 1985, however, the revenue growth slows substantially (from 27% to 8%) while the expenditures still rise at around 25%. In 1986 and 1987 the growth in expenditures is limited and relatively slow, following the growth in revenues. In 1988, the growth rate in both revenues and expenditures starts to increase again. Table 6.1 indicates that the growth in total employment follows the growth in revenues and expenditures. In 1985, when the expenditures are still high, the total employment for the organization as a whole also rises considerably, by 16%. However, in 1986 and 1987, periods of limited revenues and expenditures, the growth in total

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employment for the organization as a whole, and in each department as well, slows substantially. In 1987, all departments, except public safety, and the overall organization suffer a decrease in total employment. In 1988, as revenues and expenditures increase, the total employment in each department and for the overall organization also rises.

The second observation is that City A is highly automated: 68% of the control applications, 50% of the coordination applications, and 77% of the efficiency applications are automated and in operation. Also City A has one access point for every three employees. The DP budget indicates that most of the automation occurs in 1984 and 1985 (Table 6.2). The 107% DP budget growth from 1983 to 1985 results from a dramatic expansion of computing. While the efficiency applications are already fully automated, most control and coordination applications are automated at that time. For instance, most inventory, dispatching, and budgeting systems are computerized in 1985. Also, there are two times as many access points installed in 1985 than in 1984 (100 versus 51). The DP staff also increases by 20%. The growth in DP budget slows down afterward to around 5% per year, where most efforts are oriented toward maintenance and minor new development.

<u>The impact of IT.</u> If IT affects the occupational profile of middle managers, changes in their number are likely to differ from changes in total employment in highly automated departments. Overall, the data of City A indicate that the extent of automation decreases the number of middle managers. Table 6.1 indicates that while the total number of employees for the organization

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increases by 4% from 1985 to 1988, the number of middle managers decreases by 4% over the same period. There is therefore a differential change of 8%. More interestingly, however, the change in the occupational profile of middle managers greatly varies across departments with different levels of automation.

The impact of IT on middle managers is clearest when the analysis is disaggregated to the department level. IT decreases the number of middle managers in the departments directly related to the public, but does not have significant effect in the departments that are not directly related to the public. The general government and administrative services and the community development departments have a relatively high level of automation, but the growth in middle management is positive and somewhat larger than the growth in the total employment in each department.

This effect is markedly different from the evolution of employment in the public-related departments. The public safety, public works, and public services departments are highly automated, while the community services department has a low level of automation. The numbers of employees in the public safety and public services departments rise by approximately 6% from 1985 to 1988. However, the number of middle managers decreases by 14% in public safety and by 29% in public services over the same period. This represents a proportionate change of -20% in public safety and of -35% in public services. In contrast, the community services department, which is also directly related to the population but has a low level of automation, experiences a differential growth rate between

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the number of middle managers and the number of employees of only -8% from 1985 to 1988.

The public works department, the third highly automated public related department, experiences an increase of 33% in the number of middle managers between 1985 and 1988, while the number of employees does not grow. This may seem contradictory to the previous findings; however, it is not. It simply reflects the peculiarity of the public works department, which contracts out almost 40% of its operations. Therefore, it is not the employment that follows growth in the population and in the demand for more services, but rather the number of contracts. Because middle managers are responsible for securing and managing contracts, their number directly varies with growth in contracting. Also, the very nature of their job makes the IT impact minimal. A major portion of their efforts is devoted to keeping contact with the contractor and resolving problems with them as they occur.

Therefore, IT does affect the middle management workforce in city A, at least in departments dealing directly with the population. Highly automated departments show a negative growth rate in the number of middle managers since automation has been applied extensively. The department with a low level of automation shows a stable middle management and a small differential growth.

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City B

Tables 6.3 and 6.4 present the data for City B.

Table 6.3
Information Technology and Employment: City B

	Information Technology				Employment									
					Employees / % change					Middle managers / % change				
Department	Control	Coord.	Effi	Access	1984	1985	1986	1987	1988	1984	1985	1986	1987	1988
Public related														
Community Services	1/7 14%	0/5 0%	2/8 25%	10 6.4	56	62 11%	65 5%	64 (2%)	64 0%	4	5 25%	6 20%	6 0%	6 0%
Public Safety	14/29 48%	1/5 20%	8/8 100%	123 2.7	360	309 (14%)	317 3%	328 3%	332 1%	42	42 0%	43 2%	43 0%	43 0%
Public Works and Public Services	16/33 48%	1/5 20%	8/8 100%	45 2.9	117	119 2%	124 4%	130 5%	131 1%	11	13 18%	13 0%	13 0%	13 0%
Internal														
General Government and Administrative Services	27/38 71%	1/5 20%	8/8 100%	44 3.7	152	156 3%	161 3%	164 2%	164 0%	16	19 19%	18 (5%)	18 0%	18 0%
Community Development	0/2 0%	1/5 20%	8/8 100%	8 5.8	29	35 21%	43 23%	47 9%	46 (2%)	7	9 29%	9 0%	9 0%	9 0%
Total	64/111 58%	4/25 16%	34/40 85%	230 3.2	714	681 (5%)	710 4%	733 3%	737 1%	80	88 10%	89 1%	89 0%	89 0%

Legend

For clarity, only the first civic year is used to refer to a fiscal year. 1983 refers to the fiscal year 1983-1984; 1984 refers to the fiscal year 1984-1985, and so on.

The coordination and efficiency applications are organization-wide information systems. Numerators indicate the number of applications in operations in a particular department, and denominators indicate the number of applications in operations in the organization.

The top numbers of the access variable indicate how many access points there are in the department, and the lower numbers indicate that there is one access point for every x employees (1988).

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Table 6.4
Revenues, Expenditures, and DP budget: City B

(000$ / % change)

	1983	1984	1985	1986	1987	1988
Revenues	38,977	40,241 3%	51,764 29%	57,095 10%	53,259 (7%)	57,660 (8%)
Expenditures	35,299	40,922 16%	46,611 14%	51,534 11%	56,479 10%	57,176 1%
Net Revenues	3,678	(681) (119%)	5,153 85%	5,561 8%	(3,220) (158%)	484 115%
DP Budget	208	433 108%	748 73%	845 13%	1,242 47%	847 (32%)

Here again, as for City A, the data of Tables 6.3 and 6.4 were obtained by interviewing the director and two middle managers in each department, the director of personnel, and the DP manager. Job descriptions of several middle managers, annual budgets from 1983 to 1989, and detailed organization charts were also used to supplement the interviews.

The revenues and expenditures trend of City B is somewhat similar to that of City A, with the exception that the decrease in revenues and expenditures occurs from 1986 to 1988. In 1986 and 1987, revenues and expenditures rise at around 10%, while in 1988, revenues rise at 8% and expenditures at only 1%. The change in revenues and expenditures growth is less pronounced than in City A. The total employment follows the growth in expenditures. From 1986 to 1988, the growth in employment for the organization as a whole decreases from 4% to 1%. The overall growth rate in the number of middle managers decreases from 10% in 1985 to 1% afterward.

The DP budget presented in Table 6.4 indicates that most automation occurs in 1984 and 1985. It increases by 260% from 1983 to 1985. In those two

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years, most efficiency applications (word processing, modeling packages) and several control applications (e.g. inventory, dispatching) are automated. In 1986, the DP budget growth decreases to 13%. It increases again in 1987, when a new central computer is bought and the payroll, police, and financial management systems are revamped.

The impact of IT. Table 6.3 indicates that here again the change in the occupational profile of middle managers, rather than being relatively similar across departments like that of the total employment, varies across departments with different levels of automation. The same observation can be made regarding the impact of IT in departments dealing directly with the population and in the other departments as in City A. IT does not significantly affect the growth rate of middle managers in non-public departments. The general government and administrative services department has a relatively high degree of automation, but there is no difference between the growth rates of its middle management and total employment. The community development department has a low automation level, but the differential growth between its middle managers and total number of employee is high (31%).

The growth rates of the middle management workforce and of total employment in departments directly dealing with the population indicate that IT decreases the number of middle managers in City B. The public safety and the public works and public services departments are highly automated, and they show a very slow growth in the number of middle managers. The total employment in the public safety department grows by 7% between 1985 and 1988,

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while middle managers grow only by 2%. In the public works and services department, the total employment grows by 10%, while the middle management workforce does not change. Therefore, the differential growth rates between middle managers and the total number of employees in the public safety and the public works and services departments is -5% and -10% respectively.

In contrast, the community services department, a public related department with a low level of automation, shows a differential growth rate of 17% in favor of middle managers. The total number of employees grows by 3% between 1985 and 1988, while the number of middle managers grows by 20% over the same period.

In conclusion, IT also affects the growth of middle managers in City B, at least in the public-related departments. The growth rate of middle managers in highly automated public departments is much lower than that of the total number of employees in the departments since IT has been used extensively. The growth rate of middle management in the department that has a low level of automation is higher than the total employment in that department.

Summary of the Impact of IT on the Middle Management Workforce

In summary, four observations can be made regarding the impact of IT on the number of middle managers in City A and City B. First, the extent of automation does affect the occupational profile of middle managers. In both City A and City B, the highly automated public-related departments experience a lower growth in the middle management workforce than in the total employment.

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The level of automation is higher in City A than in City B, and so is the IT impact. In City A, the difference between the growth in the total number of employees and the growth in the number of middle managers in the highly automated departments is around -30%. In City B it is around -7%. This stronger impact in City A can also be attributed to the managerial orientation. Recall from Chapter 4 that managers of City A favor internal options such as reductions in new employees hired to mitigate revenue reductions. In contrast, managers of City B favor fiscal and external options such as increased bond financing. It seems that managers of City A have a greater propensity to use IT to facilitate mitigation of revenue reductions.

Second, the impact of IT is less pronounced than expected. IT does not decrease the number of middle managers per se in most departments but rather it permits holding them constant while the rest of the organization grows and the workload increases. Therefore, the impact of IT is not as much to decrease the number of middle managers, but rather to decrease the proportion of middle managers to the total number of employees.

Third, IT affects the occupational profile of middle managers in departments dealing directly with the population, but not in the internal departments.

Finally, the fiscal condition of the city triggers, or at least serves as an incentive in the process of the IT impact on the middle management workforce. In both cities, decreases in revenues and expenditures incite managers to reduce or limit the growth of their middle management even when the city is growing

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and the workload is increasing. The growth in middle managers is lower than the growth of other employees in departments with high level of automation. Also, when revenues and expenditures increase in City A (1988), the total employment of the city and of each department also increases. In departments with a high level of automation, the growth in middle managers remains lower.

Roles of Middle Managers

Data on how IT affects the roles of middle managers were gathered in the interviews with the middle managers through the following procedure. First, the managers were asked to describe a typical day of work in some detail as it is today, with automation. Then, the author described and differentiated the decisional, informational, and interpersonal roles and gave examples of each role relating to the domain of the interviewee. Third, together with the middle managers, we partitioned the time of the typical day into the three roles. We thus obtained the percentage of time spent in the three roles with IT. Finally, the interviewees were asked to discuss how IT has changed the focus of their efforts and the distribution of the time on each role. This gives the percentage of time spent prior to automation.

Note that we were able to obtain these data because IT has most extensively been applied lately and its impact has been felt in the very recent past (the last year or so). The managers recalled very well the changes in their jobs that IT fostered. Of course, as with any retrospective and historical analyses,

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these data may suffer from a recency bias, that is in our case, an overestimation of the importance of the IT effect. To minimize this problem, the data were verified using the job description of the respondents, most of which have not been changed since the major automation efforts of 1985. By comparing the "official" job descriptions--describing the jobs of middle managers before automation--and middle managers' descriptions, we were able to validate the interviewees assessment of the IT impact on their roles.

The study of the roles of middle managers is not an easy one. The functions managers perform are so diverse and complex that it is often hard to determine what it is exactly that managers do and, even more difficult, which functions are more important. Hence, although the study of the roles was done as rigorously as possible, data presented in this section represent approximations of the importance of each role and of the change IT fosters. Even with this limitation, data obtained in City A clearly indicate that IT significantly affects the roles of middle managers.

Table 6.5 presents the percentage of time spent on the three broad roles of eight middle managers in the three highly automated public related departments of city A before and after computerization.

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Table 6.5
Roles of Middle Managers in Highly Automated Departments: City A

	Decisional No IT	Decisional IT	Informational No IT	Informational IT	Interpersonal No IT	Interpersonal IT
Public Services						
Manager of facilities & equipment	33%	45%	33%	20%	33%	35%
Management analyst	20%	30%	40%	35%	40%	40%
General Government and Administrative Services						
Manager of fiscal services	33%	40%	33%	25%	33%	35%
Budget officer	33%	50%	33%	20%	33%	30%
Public Safety						
Commander	30%	30%	30%	30%	40%	40%
Lieutenant	30%	35%	33%	30%	33%	35%
Mean	30%	38%	35%	27%	35%	36%
% change		+27%		(23%)		+3%

Table 6.5 indicates that IT affects the importance of the informational and decisional roles of middle managers. IT takes over some informational roles of middle managers and increases the importance of some decisional roles. Four of the six middle managers report a decrease in the time spent in informational roles averaging around 25%. Most managers report that with IT, there is much less information exchanged across departments and across levels that goes through middle management. Rather, people simply access the centralized data base and different applications. For example, the financial systems of City A permit managers of all departments to directly access information about budgets and specific account spending patterns without going through middle managers of the administrative services department.

On the other hand, IT increases the time middle managers spend in decisional roles by an average of 27%. All middle managers indicate that IT increases the depth, complexity, and sophistication of the analysis performed for the unstructured decisions.

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> . . . on the one hand, computers have freed some time, but on the other hand, computers have also increased our (middle mangers) workload. Now, more in-depth analyses are expected from us when making decisions. We need to analyze more alternatives in greater details. Manager of Fiscal Services

It is significant to note that IT does not increase the number of decisions middle managers make, but rather increases the depth and complexity of the remaining decisions. Therefore, the net effect of IT on the number of middle managers is the difference between the "slack resources" created by IT taking over some informational and structured decisional roles and the increase in the remaining decisional roles.

Data on the roles of middle managers in City B are not precise enough to be used. The initial automation of the control, coordination, and efficiency systems started six to seven years ago. This long time span might strongly bias recollections of the importance of each role before and after IT. Also, most job descriptions have been updated since the initial automation, which makes it even harder to obtain and verify data concerning the changes of roles of middle managers.

Summary of the Case Study Findings

As a summary of the case study, the findings are discussed with regard to what they mean for hypothesis 1:

Hypothesis 1:

> The more centralized the decision authority, the more the extent of automation will reduce the ratio of middle managers.

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Proposition a:

> When the structure of computing authority and the structure of organization authority are centralized (extensive centralization), the extent of automation decreases the middle management workforce.

Recall that hypothesis 1 is supported by the survey findings. The case study findings also support the first hypothesis and proposition a. In the last five years, when automation has been applied extensively, the number of middle managers in the most computerized departments has constantly decreased. On the other hand, growth in middle management and in the total number of employees is comparable in departments with a lower level of automation.

The case studies also provide some insights into the dynamic of the IT impact, which will be fully discussed in Chapter 7. First, IT takes over some informational and some routine decisional roles of middle managers. It also increases the importance of and time spent on unstructured decisions. Middle managers spend more time analyzing decisions in greater depth. Second, the impact is felt in the departments dealing directly with the population (e.g. administrative and financial services) and not in the other departments. Third, the fiscal conditions of the organizations trigger the use of IT to reduce middle management, or at least serve as an incentive to top managers to use IT in this way (see the motivations underlying the managerial actions in the next chapter).

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Conclusion: Summary of the Case Study and Survey Findings

Table 6.6 presents the hypotheses and the findings from the survey and from the case study.

Table 6.6
Hypotheses and Findings on the Impact of IT on the Middle Management Workforce

Hypothesis/Proposition	Findings: Survey	Findings: Case
1 The more centralized the decision authority, the more the extent of automation will reduce the ratio of middle managers.	Supported	Supported
a When the structure of computing authority and the structure of organizational authority are centralized *(extensive centralization)*, the extent of automation decreases the middle management workforce.	Supported	Supported
b When the structure of computing authority and the structure of organizational authority are decentralized *(extensive decentralization)*, the extent of automation increases the middle management workforce.	Supported	
c When the structure of computing authority is centralized and the structure of organizational authority is decentralized *(partial centralization)*, the extent of automation decreases the middle management workforce.	Supported	
d When the structure of computing authority is decentralized and the structure of organizational authority is centralized *(partial decentralization)*, the extent of automation increases the middle management workforce.	Not Supported	
e The impact of the extent of automation is more pronounced in extensive situations than in partial situations.	Supported	
2a Top managers use the control and efficiency applications to reduce the middle management workforce	Partially supported	
2b Middle managers use the control and coordination applications to increase the middle management workforce	Supported	
3 The increase in the middle management workforce is more pronounced than the decrease in the middle management workforce	Supported	

The findings *support hypothesis 1* and the conceptual framework proposed in this study. The survey and the case studies indicate that the extent of automation decreases the ratio of middle managers in organizations with an extensive

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centralization structure of decision. The case studies indicate that the impact of IT is present in departments dealing directly with the public, but not in other departments. The case studies also provide some insights about the motivations behind managerial actions driving the IT impact, which are discussed in the next chapter. Data also *support proposition b* that IT increases the ratio of middle managers in organizations with an extensive decentralization structure and *support proposition c* that IT decreases the middle management workforce in organizations with a partial centralization structure.

Contrary to what was expected, IT decreases the ratio of middle managers slightly in organizations with a partial decentralization structure (*proposition d not supported*). Also, surprisingly, it is the efficiency applications that are the most important determinant of the IT impact rather than the control and coordination applications. Finally, it was found that the extent of automation is more pronounced in extensive situations than in partial situations (*proposition e supported*). The findings *partially support hypothesis 2a.* It was found that top managers use the coordination and the efficiency applications but not the control applications to reduce the middle management workforce. Middle managers, on the other hand, use the coordination and the control applications to increase their workforce (*hypothesis 2b supported*). Finally, *hypothesis 3 is supported.* It was found that the increase in the middle management workforce is more pronounced than its decrease.

A more general note; it was also found that the structure of computing authority moderated the IT-middle management relationship alone, but that the

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structure of organizational authority does not. However, the greatest knowledge gain is obtained when both the structure of computing authority and the structure of organizational authority are used as moderator variables as the framework stipulates.

The next chapter discusses what these findings mean for previous work, and it discusses the mechanism that explains the findings.

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Chapter VII

Discussion: The "Substitution" Effect

Chapters 5 and 6 present the findings describing how IT affects the occupational profile of middle managers. This chapter interprets and discusses the findings with regard to what they mean for previous work and for the conceptual framework presented in Chapter 3. It also presents and discusses the "substitution" mechanism and applies it to the four situations of the framework. This chapter first begins, however, by discussing the findings with regard to the two questions we sought to answer when we designed this study: (a) What is the impact of IT on the number of middle managers--does it increase or decrease their number? and (b) How and why does the impact of IT occur?

What is the IT Impact on the Middle Management Workforce?

Research reported in the literature is quite divided about this. Case studies and a nation-wide study conducted between 1960 to 1988 in several industries and in a multitude of organizations found that IT decreases the number of middle managers. On the other hand, a more impressive number of studies found that IT increases the number of middle managers. We found that overall, IT increases the number of middle managers in city governments. However, and most important, it was also found that this overall positive relationship hides a set

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of positive and negative relationships between IT and the middle management workforce that follows the conceptual framework presented in Chapter 3 (see Tables 3.1 and 6.6). In fact, by disaggregating the level of analysis, IT was found to decrease the ratio of middle managers in three types of organizations (extensive centralization, partial centralization, partial decentralization), and increase it in one type of organization (extensive decentralization). Data provide strong support to the conceptual framework. There is only one instance (partial decentralization) where the expected outcome was not found.

As expected, the strongest impact of IT occurs in organizations with an extensive structure. IT decreases substantially the ratio of middle managers in organizations where the structure of organizational decision and the structure of computing decision are centralized. IT increases substantially the ratio of middle managers in organizations with an extensive decentralization structure. The structure of computing authority and the structure of organizational authority are decentralized, and they reinforce each other's moderating effect. In both partial situations, IT decreases the ratio of middle managers slightly.

The finding of a contingency-driven IT impact obtained here fits well with studies of the IT effects on other dimensions of organizations (Bjorn-Andersen et al., 1986; Danziger et al., 1982; Kraemer and Dutton, 1979; Robey, 1983). However, this finding places this study alone among the group of studies on the IT impact on the middle management workforce. All previous studies found IT to either increase or decrease middle managers, but not to do both. Nonetheless, the present findings rest on strong empirical evidence which in many ways enables

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a more precise and probably more valid assessment of the IT impact on the middle management workforce.

First, this study disaggregates the analysis to a level which permits a finer understanding of how and why IT affects the middle management workforce. It is based on the study of the very basic effects of IT, rather than being one step removed from those elementary effects, as the previous studies were. Second, by focusing on governmental institutions, potential confounding effects of production technology are eliminated. Third, the sector specific approach makes the sample more homogeneous and facilitates an understanding of the phenomenon. Greater confidence can be placed in the results. They are more likely to reflect reality and not simply be an artifact of a confounding effect of some unknown third factor. Fourth, the findings are based on both a survey and case studies. The survey is nation-wide and has the third largest sample after Meyer (1966) and George (1986). The case study is based on the in-depth analysis of two organizations through over thirty interviews with managers of different levels and departments. Complementary sources of information such as annual budgets, organization charts, and detailed job descriptions were also used to supplement the interviews. This design provides richer information and a more encompassing understanding of the impact of IT on the middle management workforce than the designs of previous studies. Finally, unlike several previous studies, this study is based on concepts that are clearly and precisely defined and operationalized. This makes this study easier to replicate and the findings more precise and reliable.

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The Mechanism by which the IT Impact Materializes

If computing does indeed increase and decrease the ratio of middle managers as the findings of this study indicate, the next important question that ought to be asked, is what is the mechanism by which the IT impact materializes? One mechanism that was just proposed by Kraemer et al. (1989) relates well to the present findings, although it is different in scope. The "cascade" mechanism proposed by Klatzky (1970) and the "gravity" mechanism proposed by George (1986) could also be useful; however, their scope is too limited to explain the present findings. They relate strictly to the decentralization of decision authority due to computing use.

Kraemer et al. (1989) studied six city governments and one county government in an effort to determine the roles and the importance of environmental changes and managerial action in computing package changes. In particular, they were interested in determining the role of management action in mediating the effects of environmental influences on computing activity. They found that while both factors are important, managerial action is the most significant force in determining changes in the computing package. Managerial action is the critical mediator between environmental conditions and computing conditions, and in some instances initiates changes in the computing package independently of environmental conditions. Managerial action in response to environmental changes usually determines whether or not environmental conditions will affect the computing package, and if so, in what ways. Kraemer et

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al. (1989) also found cases, although less frequently, of managers taking action about computing in the absence of any apparent environmental stimulus.

This broad mechanism fits our findings well. The mechanism behind the impact of IT on the ratio of middle managers converges with that of Kraemer et al. (1989). However, the dynamic of our mechanism and the importance of its components differ from Kraemer et al.'s mechanism. Management action is the fundamental determinant of the IT impact, rather than just a mediator, and the environment only triggers management action. Environmental factors do not affect directly or indirectly the IT impact on the middle management workforce, as Kraemer et al. (1989) would argue. It was also found that while changes in the middle management workforce result sometimes from management actions independent of environmental stimulus, in most cases, they are triggered by environmental stimulus.

The findings also support the assumptions underlying George's "gravity effect" and Klatzky's "cascade effect" that IT permits managers to be more efficient and to perform some routine and structured functions faster. The survey and the case studies indicate that the coordination and the efficiency applications either facilitate or take over some informational roles and some routine and structured decisional roles. This creates slack resources at the middle management level. The key question is, what happens with the slack resources?

Klatzky and George suggest that the slack resources are filled by new decisions, either pushed down by top managers or pulled down by lower level managers. However, the case studies in this research do not support Klatzky's or

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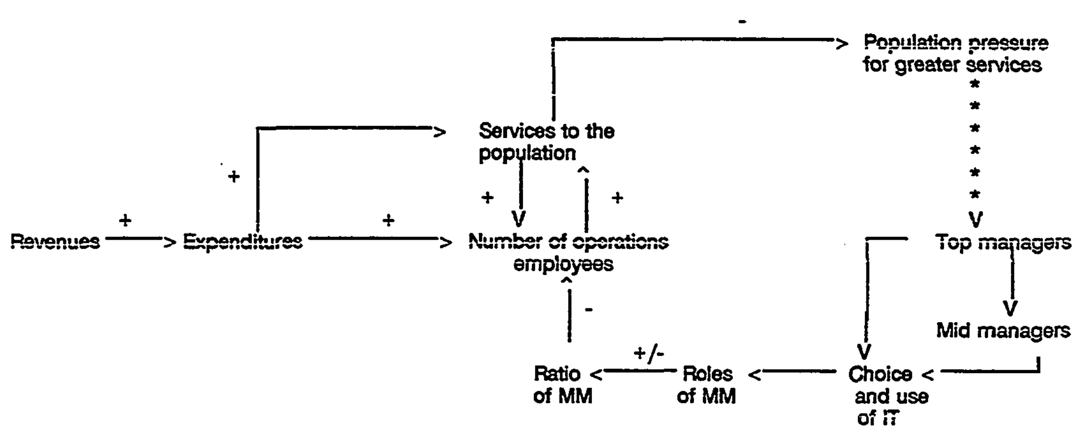
George's view. Rather, the case studies indicate that the slack resources are filled by what we call the "substitution" effect. The slack resources are substituted either (a) by an expansion of the attention given to unstructured decisions and of the middle management workforce, or (b) by a consolidation of middle management jobs and a reduction in their number, and an expansion in the operation employee workforce. Figure 7.1 presents the "substitution" mechanism.

Figure 7.1
The "Substitution" Mechanism



MM	=	Middle managers
****	=	Real or perceived pressure.
+ (line)	=	Positive relationship. The factors move in the same direction (e.g. when one factor increases the other factor also increases).
- (line)	=	Negative relationship. The factors move in opposite directions (e.g. when one factor increases the other factor decreases).
+/- (line)	=	The relationship can be either positive or negative.

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The mechanism indicates that what determines which foregoing avenues will be used by the managers to fill the slack resources is top managers' perception of population pressure for greater services, which is triggered by reduction in revenues and expenditures. The two avenues and the context in which they are used are discussed next.

Absence of Population Pressure: Expansion of Middle Management

When *top managers perceive no pressure* from the population, they, and middle managers, use IT to increase the middle management workforce. This results from two related phenomena. First, the *motivation and interest of managers* in organizations is to increase the number of managers under them. The motivations behind managerial actions became clear in the case studies. As expected and often posited in the management literature, the interests of middle managers are reflected in two forces: on the one hand, an identification with top managers and their goals of growth, greater efficiency, centralization of decision authority, and survival of the organization; and on the other hand, an attempt to further personal ambitions (autonomy, achievement, greater decision authority and power) through the growth of their unit and the circumvention of control systems (Mintzberg, 1983; Stewart, 1987). Middle managers favor the attainment of personal objectives through computing because their prestige, status, power, and salary basically depend on the size of the unit they manage.

It is clear that the interests of higher level managers are also reflected in two forces regarding middle managers. On the one hand, top managers have

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interests in reducing the number of middle managers. Middle managers are a source of uncertainty for top managers because they may alter consciously or unconsciously the information they transmit and receive. This creates uncertainty for top managers because the interests of the two groups are not totally compatible. Top managers reduce this uncertainty by using IT to gain greater control over information and to eliminate middle managers. On the other hand, top managers, like middle managers, also have an interest in increasing the number of middle managers reporting to them because their status, prestige, and salary increase with the growth of the units they manage. Therefore, *by default*, attention to the unstructured decisions expands so as to fill the time available to middle managers, which increases their importance to the organization and their number.

The second phenomenon underlying the expansion of middle management is that computerized information systems *uncover details about decisions not previously known*. Middle managers perform more in-depth analyses because the computer allows them to scrutinize and evaluate a greater number of alternatives in greater depth. The complexity, sophistication and extensiveness of the remaining decisions increase substantially. In addition, usage of computerized information systems raises the expectations of superiors and colleagues with regard to information and decision quality. This compels middle managers to use the extra capability and time available and to analyze the remaining decisions in greater depth. Therefore (referring to Figure 7.1), increases in revenues and expenditures entail increases in services to the population and in the number of

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operations employees. The increase of services and the increase in operational employees influence each other. Increases in employees lead to increases in services, and vice versa.

Increasing services to the population reduces dissatisfaction on the part of the citizens and the pressure they put on top managers for better services. The dotted line in Figure 7.1 between population and top managers indicates that it is top managers' perception of pressure that creates an incentive to use IT to reduce middle management. Really strong pressure from the population that is not perceived by top managers will not affect them. Conversely, weak pressure perceived as strong by top managers will serve as a strong incentive. Top managers do not perceive pressure from the population, and therefore, they will choose and initiate the use of the IT that permits middle managers to expand their attention to unstructured decisions and increase the importance and number of middle managers in the organization. This increase in the middle management workforce will not have a significant effect on the number of operations employees in a period of increasing revenues and expenditures.

Population Pressure: Displacement of the Slack Resources

However, as illustrated in Figure 7.1, although the intrinsic interests of the managers in organizations are toward increasing the middle management workforce, perceived population pressure by top managers actually compels them to initiate the use of IT to reduce middle management. In this situation, the slack resources created by IT facilitating the consolidation of middle managers

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jobs and the reduction of their number are absorbed in the organization by an increase in the operations employee workforce. Top managers' efforts are moderated by who controls computing decision and what the roles of middle managers are.

Figure 7.1 presents the mechanism by which this process occurs. Decreases in revenues entail decreases in expenditures, which in turn lead to a reduction, in real or proportionate terms, of the number of operations employees and of the services provided to the population. This creates dissatisfaction on the part of the citizens and heightens the pressure they put on top managers for greater services. Top managers feel pressured to increase services and the number of operational employees, but they are limited by expenditure constraints. In response, top managers initiate the choice and/or usage of the IT that reduces the number of middle managers in order to create slack resources. The efforts of top managers to influence the choice and usage of particular IT can be indirect (through middle managers) when computing decision authority is decentralized, and both indirect and direct when computing decision authority is centralized. Top managers then fill the slack resources by increasing the number of operations employees. This increases the service level and decreases population pressures, while respecting expenditure constraints.

Top managers thus strategically transfer outside pressure within the organization, where they are less vulnerable and where they control matters. Top managers are evaluated and rewarded on the basis of the quantity and quality of services provided more than on the basis of efficiency or any other measure of

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the internal functioning of the organization. Therefore, top managers attain their goal by increasing the level of services and the number of operations employees, which reduces population dissatisfaction and the pressure it exerts on them. They counter this increase in expenditures by decreasing the middle management workforce. In addition, the mere use of IT provides an "image" of efficiency. When IT is accompanied by staff reductions at the middle level, the "image" is given special credence.

Displacement of the slack resources and the four contingent situations. The efforts of top managers to substitute the slack resources at the middle management level by increasing the operations employee workforce are moderated by who controls computing and by the roles of middle managers. The resulting effect is therefore different in the four situations of the framework. In the *extensive centralization* situation, top managers can greatly influence the choice and usage of IT. When they perceive pressure from the population to increase the service level, top managers initiate the use of IT to reduce the middle management workforce. Middle managers perform mostly structured decisional roles and informational roles in those organizations. Top managers initiate the use of the efficiency applications, which have the greatest negative impact on the number of middle managers given their roles. In that context, the efficiency systems can greatly increase the efficiency of a large part of the horizontal (trans-departmental) and vertical (trans-hierarchical) communication through its communication components (e.g. E-mail). Also, the statistical and modeling components may greatly support and take over some structured decisions. The

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coordination applications are also favored because they can take over significant portions of the horizontal informational roles of middle managers.

The control applications are not used by top managers because they increase the ratio of middle managers. The vertical information systems are mostly used between middle management and operation level management, but not between top management and middle management and top management and operations management. Middle managers use the control applications to gather information about the operations that make them the vertical information gatekeepers of the organization. Top managers, probably because of their focus on external environment rather than on internal organization functioning, do not use the control oriented applications to bypass middle managers and to reduce their number. The control systems increase slightly the informational roles of middle managers and foster the swelling of the more unstructured decisional roles. However, because in centralized organizations, middle managers perform few unstructured decisional roles, the swelling does not substitute fully for the slack resources created by decreased informational and structured decisional roles. The remaining slack resources are absorbed in the organization by increases in the number of operations employees.

In the *partial decentralization* situation, the roles of middle managers are also mostly informational and structured decisional. The three types of applications have the same relative importance as in extensive centralization. However, the computing decision authority is decentralized at middle managers, and therefore top managers can only influence computing choice and use

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indirectly, through middle managers. Top managers are thus less able to initiate the use of IT to reduce the middle management workforce. The negative effect of the efficiency and coordination applications is less pronounced than in extensive centralization. The positive effect of the control applications is the same as in the extensive centralization situation.[1] Recall that middle managers are always able to use the control applications to achieve their ends. The resulting overall effect of IT in the partial decentralization situation is a slight decrease in the ratio of middle managers.

In the *partial centralization* situation, computing decision authority is centralized at the top level, but middle managers perform mostly unstructured decisional and a few informational roles. In this situation, top managers have a great influence on computing both directly and indirectly, but the roles of middle managers are not easily amenable to computerization and limit top managers' efforts. Top managers favor the coordination applications because they are the information systems that have the greatest negative impact on the ratio of middle managers. The coordinations applications take over some horizontal informational roles, which is the only way a reduction in the middle management workforce can be achieved given their roles.

However, the control and efficiency applications both increase the ratio of middle managers. As discussed above, the control applications foster the swelling of unstructured decisions to substitute for the slack resources created by the coordination applications. The major support provided by the efficiency oriented systems is modeling and statistical capabilities. This also expands the

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unstructured decisional roles of middle managers by providing more information about decisions and inciting more in-depth analyses. Therefore, although top managers try to reduce middle management workforce by coordination applications, they can only affect a very small portion of the middle managers' roles. The control and the efficiency applications expand the unstructured decisional roles, which substitutes in large part for the slack resources created by the coordination applications. The overall effect is therefore a slight decrease in the middle management workforce.

Finally, *extensive decentralization* is the only situation where IT increases the ratio of middle managers. Middle managers control computing decisions and their roles are mostly unstructured decisional and therefore not easily amenable to computerization. In this situation, computing is isolated enough from top managers that middle managers are able to choose and use it in accordance with their goal of growth. Top managers have no direct influence on computing decisions and only a very weak indirect influence, through middle managers. Here also, as with the partial centralization situation, the coordination applications have the strongest impact on the ratio of middle managers, followed by the control and efficiency applications. However, the negative impact of the coordination applications is two times smaller than in organizations where top managers control computing.[2] Middle managers are able to choose and use the coordination applications so that the loss of some horizontal informational roles is lessened. Middle managers are also able to favor a greater use of the control and efficiency applications that expand their unstructured decisional roles. Their

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positive impact is two times stronger than in organizations where top managers control computing. The overall effect is that IT increases the ratio of middle managers.

Observations Regarding the "Substitution" Mechanism

Three observations need to be made regarding the "substitution" mechanism. First, the mechanism explains why the impact of IT on the number of middle managers is negative in public-related departments, and small and positive in non-public departments. By their very nature, the public departments are the ones most affected by the population pressures for greater services and, therefore, more subject to top managers' efforts to initiate the use of IT to reduce middle management. The non-public departments do not provide services to the population and there is less pressure to increase the efficiency of operations. Therefore, computing is less subject to top managers' efforts to reduce the middle management workforce. Rather, computing is used to achieve self-interest growth objectives of both middle managers and top managers (the expansion avenue).

Second, the "substitution" mechanism entails a lag structure. The case studies indicate that the lag between decreases in revenues and decreases in the middle management workforce is of about four years. The lag structure between the time top managers influence computing to reduce the middle management workforce and the actual IT effect is two to three years. Tables 6.1, 6.2, 6.3, and 6.4 indicate that major computing efforts occur in 1984 and 1985 in the two cities and that the impact of IT on the middle management workforce occurs in 1986

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and 1987. The lag structure found in this study is relatively consistent with that of Brynjolfsson et al. (1988), who found a lag structure of up to five years between growth of IT capital and decrease in the managerial workforce. The somewhat shorter lag structure observed in this study results from the fact that it focuses on middle managers only, and they are the first managers affected by increased computing. Brynjolfsson et al. studied the managerial workforce in general. Also, this study focuses specifically on the IT that is most likely to affect middle managers, whereas Brynjolfsson et al. (1988) used broad and aggregated measures of IT.

The final observation is that the displacement avenue seems to work even in cities that are not fully automated when revenues and expenditures decrease. In both City A and City B, top managers increased the DP budgets greatly one year after revenues and expenditures decreased (see Tables 6.2 and 6.4). That is, when pressure from the population starts to be felt, top managers allocate substantial budgets to computing and make computing decisions that facilitate the reduction of the middle management workforce and the growth of operations employees. Top managers are cognizant of the instrumental value IT in reducing population pressure and bringing it inside the organization, and they use it as such, even if it necessitates spending money in a period of weak revenues.

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Conclusion

This chapter discusses what the findings of the present study mean for previous work and for the conceptual framework. The chapter presents the "substitution" mechanism, which explains the change in the occupational profile of middle managers, the dynamic process underlying changes in the middle management workforce, and the motivations behind managerial actions. Finally, this chapter discusses how the "substitution" mechanism works in the four situations of the framework and how it accounts for the findings of the present study in each situation.

The next chapter concludes this study by summarizing the findings and discussing their importance and their implications for future research.

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Endnotes

1. The difference in the influence of each variable can be determined by the unstandardized regression coefficients. The regression equations of Figure 5.3 indicate that the effect of the control applications is relatively similar in both situations, while the negative effect of the coordination applications is almost three time less pronounced and the efficiency applications impact almost two times less pronounced in partial decentralization than in extensive centralization situations.

2. The unstandardized coefficients of the regression equations of Figure 5.3 indicates that the negative effect of the coordination applications is twofold smaller in extensive decentralization organizations than in partial centralization organizations. The positive effects of the control and efficiency applications are about two times stronger in extensive decentralization than in partial centralization.

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Chapter VIII

Concluding Remarks:

Summary and Implications of the Findings

This chapter has three purposes. First, it summarizes the findings of this study and discusses what we have learned. Second, it discusses the importance and implications of the findings for future research, and it considers the additional research that can be done to gain greater knowledge about how and why IT affects middle managers and organizations in general. Third, it reflects on the findings in the context of the broader issues of technological, organizational, and societal changes discussed in Chapter 1.

Summary of the Findings: What Have We Learned?

There are two questions we sought to answer when we designed this study: What is the impact of IT on the middle management workforce? Why and how does this impact occur?

What is the Impact of IT on the Middle Management Workforce?

Overall, IT increases the ratio of middle managers to the total workforce in the city. When city governments are studied at the aggregated level there is a positive relationship between computing and the size of the middle management

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workforce. However, this positive effect of IT is composed of a set of negative and positive effects. In fact, by disaggregating the level of analysis based on who controls computing and on the roles of middle managers, a much better assessment of IT impact was obtained. More than 30% of the variance in the ratio of middle managers was explained.

This study provides the following specific findings. When top managers control computing and the roles of middle managers are structured, IT strongly decreases the ratio of middle managers. When the roles of middle managers are less structured, IT still decreases the middle management workforce, but to a lesser extent. When computing authority is decentralized at the middle management level and their roles are also structured, IT also decreases the middle management workforce. Finally, when the roles of middle managers are mostly unstructured and they control computing, IT increases the ratio of middle managers.

Top managers use the coordination and the efficiency application to reduce the middle management workforce, and middle managers use the control and the coordination application to increase their number and importance in the organization. The importance and significance of each type of application varies across situations. When the roles of middle managers are unstructured, the efficiency applications are the most influential, the coordination are the second most influential, and the control applications are the least important. On the other hand, when the roles of middle managers are structured, the coordination applications are the most influential, followed by the control and efficiency

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applications. It was also found that the control oriented applications always increase the number of middle managers. This is quite interesting because it contradicts the arguments of Leavitt and Whisler (1958) and Applegate et al. (1989) about why IT decreases the middle management workforce. Their argument is that most of the reduction in the middle management workforce results from the capability provided by IT for top managers to bypass middle managers in vertical communications. Rather, than being excluded from such communications, it was found that middle managers control the vertical information systems. They use these systems to link themselves more closely to the operations, to obtain and control more information, and thus to increase their importance to the organization and their number.

The case studies indicate that the negative impact of IT occurs in departments dealing directly with the population (e.g. public service, public works) but not in other departments. The negative impact of IT on the number of middle mangers is triggered by decreasing revenues, which compels top managers to exert pressure to use the IT that reduces the middle management workforce.

Finally, the findings support the framework proposed in Chapter 3. The greatest knowledge gain is achieved by using both the structure of organizational decision and the structure of computing decision as moderator variables. The impact of the extent of automation varies with the concentration of decision authority in the organization.

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Why and How does the IT Impact Occur?

The second issue addressed is by what mechanism the IT impact materializes? In answer to this question we provide the "substitution" mechanism. The mechanism shows that the impact of IT on the number of middle managers results from top managers transferring outside pressure inside the organization. IT is used to reduce the structured decisional and the informational roles of middle managers, which creates slack resources. The slack resources are either filled by an increased attention to the unstructured decisions or absorbed in the organization by the consolidation of middle managers' jobs, the reduction of their number, and the increase in the operations employees workforce. What determines which avenue is favored is who controls computing decision and what roles middle managers play in the organization.

Overall, whether it increases or decreases the middle management workforce, IT (a) makes middle managers' jobs more complex, (b) requires them to use more judgment, knowledge, and experience, and (c) increases the importance of their managerial skills as the more unstructured decisions swell to substitute for the more routine jobs.

Implications of the Study

This study has two major implications for research. First, it clearly indicates that the greatest knowledge about the impact of IT on the middle management workforce is gained by sector specific research. As stressed again

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and again throughout this dissertation, more precise and clearer definitions and conceptualizations of the concepts of middle managers and IT are needed if we want to understand better the relationship between them. This can be best achieved with homogeneous samples. Also, the findings stress the importance of some external environmental factors, which are more easily recognized, understood, and taken into account when one focuses on a set of organizations sharing a common environment. For example, the case studies indicate that the economic conditions of the city and the trend of its share of federal and state revenues trigger a mechanism in which the population comes to pressure the top managers of the city, which top managers handle by reducing the middle management workforce and increasing the operations employees workforce. These important environmental factors surrounding the organization and how they affect the IT impact might not have been recognized and understood using a cross-sector approach.

The second major implication for research is that the findings of this study increase the complexity of research on the subject. Previous studies mainly focused on the relationship between one dimension of IT and the number of middle managers. This study heightens the importance of broadening the research attention to also consider who controls computing decisions and what interests are being served through its usage. This necessitates an understanding of the capabilities of IT and the roles of middle managers, on the one hand, and of who controls major computing decisions, what dynamics computing decisions

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entail, and what the nature and mechanisms of political mobilization are, on the other hand.

The implication of the present study for organizations in general is that in the long run, both an "hourglass" structure and a "bulging pyramid" structure are likely to become more acute and more common. Because the IT impact is fundamentally determined by managerial action, the shape of the organization structure depends on the interests served by IT and, to a lesser extent, on the roles of middle managers and the economic and environmental conditions of the firm.

The findings of this study suggest that the hourglass structure will develop in organizations with a weak or weakening economic condition or with a highly competitive environment. However, case studies indicate the reduction in the middle management workforce will occur in departments dealing directly with the public or customers but not in the other departments. Therefore, in private organizations, top managers will reduce the middle management workforce in the sales, marketing, and production departments to be able to increase the operations level workforce (mostly the sales workforce) so as to compete better and strengthen the economic and fiscal conditions of the firm. The middle managers of the other departments will not be affected unless top managers need extra slack resources to increase the customer-related operational workforce.

In other situations, the bulging pyramid is likely to develop because, as discussed in length in this dissertation, top managers and middle managers have an interest in using IT to increase the middle management workforce, and they

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will do so. We expect that similar IT impacts will occur in private organizations, but that they will be more pronounced. Typically, private sector organizations are more sensitive to environmental forces because their responsiveness to them, or lack thereof, determines whether or not they survive. Also, managers in private organizations may more easily modify the workforce of their organizations, be it managerial or otherwise.

Future Research

This study is particularly important because of how it supplements previous studies. Past research has looked at the IT impact on the occupational profile of middle managers at an aggregated level of analysis. Their contradictory results rapidly fuelled debates over whether IT increases or decreases the middle management workforce, which ultimately ended in an empirical paradox. This study disaggregates the level of analysis and provides ground for transforming the empirical paradox into a solvable problem. It paves the way for a new, exciting, and potentially very insightful program of research.

Further research now needs to be conducted to determine whether the research approach and the findings of this study are specific to local governments or if they also apply to a broader spectrum of organizations. It would be useful to replicate this study in private sector organizations. More research is also needed to further test the "substitution" mechanism and the conceptual framework proposed in this study. Although they have a defensible logic and are based on

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extensive empirical work, further tests in the same and other industries could certainly enhance and refine them. For this, both large scale survey and in-depth case studies of fewer organizations are needed. In addition, more research is needed to better understand why the IT impact is different in public-related departments than in internal departments, and what it means for private organizations. This is particularly important because it might lend insights into the process by which the IT impacts materialize and might further our understanding of the phenomenon. Finally, although this study explains 30% of the variance in the ratio of middle managers, 70% remains unexplained. This indicates that many variables necessary to predict and fully understand changes in the occupational profile of middle managers are still missing. The addition of environmental factors such as competitiveness, stability, and turbulence are certainly avenues to consider. Also, other types of IT may be included, and those used in this study may be refined further, especially in studies of other industries.

After substantial research has been conducted in diverse industries, it will be possible to bring the results together and elaborate a broader general theory explaining how and why IT affects the occupational profile of middle managers. However, this study indicates that this can only be achieved by doing sector specific research first, then developing a general theory and testing and refining the theory through cross-sector research.

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Information Technology, Organization, and Society

This study begins with a broad discussion of IT as a factor of change in organizations and societies in general. Because this is much too broad to be addressed in any one study, we decided to focus on a more limited sub-set. As with any generalization, extrapolating the findings of this study to the broader issue of IT and society is fraught with danger. However, because the real world is too complex for us to understand it fully, generalizing specific findings is the only way we will ever begin to understand the broader context in which we live.

That said, we make two observations relating the study and its findings to the broader context. First, the IT impacts observed in this study, as well as in all other studies, are the tip of the iceberg. The information technology revolution is only in its infancy. The extensiveness of the IT application is relatively high within organizations, but it is very low across organizations. And, as discussed in Chapter 1, the IT impact will be fully felt when IT provides the capability of linking members across departments and across organizations. Therefore, the findings of the present study are only a harbinger of more pronounced organizational and societal changes.

Finally, the findings of this study are a clear indication that technology is a major force of organizational and societal changes. Yet, it is also clear that managerial action fundamentally determines how technological changes affect, or not, organizations and societies. Technology is only an instrument that is not by itself sufficient to significantly alter organizations and societies. Rather, it is the

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pattern in the stream of managerial actions, pursuing the attainment of self-interested objectives, that determines technological impacts. In its broadest sense, this study suggests that in the end, human volition is the ultimate agent of change. An anthropomorphic and deterministic perspective such as Winner's *Autonomous Technology* and Ellul's *The Technological Society* does not fully reflect the reality of how and why technology, people, and society really interact and affect each other.

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Appendix A

List of the Three Types of Applications

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List of Individual Applications

	Department	Applications ("Computer and Applications" questionnaire number)
A) Control applications		
	Public safety	Computer-aided dispatching--police (A24) Automated vehicle monitoring--police (A25) Automated vehicle navigation--police (A26) Enforcement manpower allocation--police (A33) Other manpower allocation--police (A34) Vehicle maintenance records--police (A38) Payroll preparation and accounting--police (A39) General accounting--police (A40) Cost accounting--police (A41) Police employee records--police (A42)
		Fire dispatching records--fire (B4) Computer-aided dispatching--fire (B5) Automated vehicle navigation--fire (B6) Fire apparatus inventory--fire (B11) Fire vehicle inventory--fire (B12) Manpower allocation and distribution--fire (B16) Vehicle maintenance records--fire (B17) Payroll preparation and accounting--fire (B18) General accounting--fire (B19) Cost accounting--fire (B20) Fire employee records--fire (B21)
		Payroll preparation and accounting--courts (C21) General accounting--courts (C22) Cost accounting--courts (C23)
		Dispatching--medical emergency (E1) Computer-aided dispatching--medical emerg. (E2) Manpower allocation--medical emergency (E6) Vehicle maintenance--medical emergency (E7) Vehicle/equipment inventory--medical emerg. (E8)
	General Government and Administrative Services	General accounting--accounting (F1) Cost accounting--accounting (F2) Bonded debt and interest accounting--account. (F3) Fixed assets--accounting (F4) Check preparing and issuing--accounting (F5) Check reconciliation--accounting (F6) Payroll prep. and accounting--accounting (F7) Retirement and pension records--accounting (F8) Internal audit reports--accounting (F9) Insurance records--accounting (F10)
		Property tax billing & collection--treasury (G1) Nonproperty tax billing & collection--treasury (G2) Delinquent tax records--treasure (G4)
		Budget preparation--budgeting (I3) Program budget preparation--budgeting (I4) Program related to line item budget--bdgting (I5) Budget monitoring system--budgeting (I6) Budgetary and financial analysis--budgeting (I7) Productivity measurement--budgeting (I8) Program effectiveness measurement--budgeting (I9) Cost of services analysis--budgeting (I10) Vehicle routing--budgeting (I12) Personnel routing--budgeting (I13) Admin. redistricting/workload bal.--budgeting (I15)
		Requisition records--purchasing & inventory (J1) Bid records--purchasing & inventory (J2) Purchase order records--purchasing & invent. (J3)

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Specification records--purchasing & inventory (J4)
Central stores inventory--purchasing & invent. (J7)
Capital/office equipment--purchasing & invent. (J8)

Position control--personnel (K1)

Bldg maint. records/schedul.--public bldg (P1)

Motor vehicle equip./parts--central garage (R1)
Motor vehicle maint. records--central garage (R2)
Motor vehicle utilization rec.--central garage (R3)
Gas consumption records--central garage (R4)
Fuel dispensa./actg/monitor.--central garage (R5)

Cost accounting--libraries (GG10)

Community Development

Land use inventory--planning and zoning (T1)

Cost actng--housing, commu. dev. (U5)

Public Works

Business license records--licensing (V4)
Business license inspections--licensing (V5)
Fictitious business name--licensing (V6)
Building permits--licensing (V7)
Safety licenses--licensing (V8)
Building complaint records--licensing (V9)
Bldg inspection records/schedu.--licensing (V10)

Project status and scheduling--engineering (W4)
Project cost accounting--engineering (W5)

Cost accounting--water supply (AA8)

Inventory and location--utilities-water (BB1)
Field order dispatching--utilities-water (BB3)
Utility accounting--utilities-water (BB5)
Vehicle maintenance records--utilities-water (BB9)
Payroll prep. and account.--utilities-water (BB10)
General accounting--utilities-water (BB11)
Cost accounting--utilities-water (BB12)
Employee records--utilities-water (BB13)
Field order dispatching--utilities-electricity (BB16)
Utility accounting--utilities-electricity (BB18)
Vehicle maint. records--utilities-electricity (BB22)
Payroll prep. and account.--utilities-elect. (BB23)
General accounting--utilities-electricity (BB24)
Cost accounting--utilities-electricity (BB25)
Employee records--utilities-electricity (BB26)
Field order dispatching--utilities-gas (BB29)
Utility accounting--utilities-gas (BB31)
Vehicle maintenance records--utilities-gas (BB35)
Payroll prep. and accounting--utilities-gas (BB36)
General accounting--utilities-gas (BB37)
Cost accounting--utilities-gas (BB38)
Employee records--utilities-gas (BB39)

Public Services

Streets & hwys inventory/location--strt & hwy (Y1)
Maint. record/schedul./monitor.--strt & hwy (Y4)
Construct. record/sched./monitor.--strt & hwy (Y5)
Maint./construct. equip. invent.--strt & hwy (Y6)
Cost accounting--strt & hwy (Y7)

Equipment and manpower alloca.--sanitation (Z1)
Cost accounting--sanitation (Z14)

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	Community Services	Manpower schedul.--public health-clinic (CC7) Manpower schedul.--public health-hospital (CC29) Manpower allocation--public welfare (DD4) Parks and rec. facility invent.--parks & rec. (EE1) Manpower allocation--parks & recreation (EE6) Vehicle maint. schedul./record--parks & rec. (EE8) Cost accounting--parks & accounting (EE9)
B) Coordination applications	General government	Street address conversion (N1) Address coding guide (N2) Master address directory (N3) Geographic data base (N4) Address matching (N5)
C) Efficiency applications	General government	Calendaring (M1) Electronic mail (M2) Word processing (M3) Text editing/text formatting (M4) Spread sheet analysis (M5) Statistical analysis (M6) Business charts and graphics (M9) In-house printing/publishing (M10)

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Appendix B

The Questionnaires

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UNIVERSITY OF CALIFORNIA, IRVINE

ICMA
INTERNATIONAL CITY MANAGEMENT ASSOCIATION

NATIONAL STUDY OF URBAN INFORMATION SYSTEMS

NATIONAL LEAGUE OF CITIES

LOCAL GOVERNMENT DATA PROCESSING COMPUTERS AND APPLICATIONS SURVEY 1985

GMIS
GOVERNMENT MANAGEMENT INFORMATION SCIENCES

PTI
PUBLIC TECHNOLOGY INC.

CAN
CALIFORNIA ARIZONA NEVADA INNOVATION GROUP

FIG
FLORIDA INNOVATION GROUP

VIG
VIRGINIA INNOVATION GROUP

Dear Data Processing Manager:

This questionnaire, along with the Management and Planning Questionnaire, is intended to collect information about the computer installation you now manage. Data from both these questionnaires will be combined with data from other cities nationwide, to identify the current state of computing technology in local governments.

We would greatly appreciate you, the manager of this installation, completing this questionnaire, or verifying the information provided if it must be completed by others. Please answer the questions only with respect to the installation you manage. We will contact any other computer installations within your government.

In appreciation of your efforts, we will send you the 1985 version of the Municipal Information Systems Directory, a compilation of survey data from all participating governments. The 1975 Directory, resulting from our previous national survey, proved an invaluable resource guide for municipalities interested in the state-of-computing across the nation.

This study is being done with the cooperation and endorsement of the International City Management Association, Government Management Information Sciences, the National League of Cities, Public Technology Incorporated, the California Arizona Nevada Innovation Group, the Virginia Innovation Group and the Florida Innovation Group. Findings from the study will be disseminated through the newsletters and publications of these associations and through articles in professional journals.

Thank you for your time and participation. If you have any problems or questions concerning the completion of this questionnaire, please feel free to call us collect at (714) 856-5449. We would appreciate it if you could return the questionnaire to us within the next two weeks. A return envelope is enclosed for your convenience

Sincerely,

Kenneth L. Kraemer

Professor Kenneth L. Kraemer

PUBLIC POLICY RESEARCH ORGANIZATION

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TOPICAL OUTLINE OF QUESTIONNAIRE

Part I. Computer Operations

- **Primary Systems Inventory**
- **System Utilities Inventory**

Part II. Applications Development

- **Software Development Techniques**
- **Applications Development Languages**
- **Programmer Activity, Training and Experience**
- **Sources of Applications**
- **Application Transfer: Operations**
- **Application Transfer: Planning and Management**
- **Application Transfer To Other Governments**
- **Turnkey Systems**

Part III. Applications Inventory

Note: There are a variety of names used to refer to the information systems function in organizations. These include: data processing, information systems, information management, information resource management, and so forth. We use DATA PROCESSING for simplicity and consistency. Consequently, we refer to you, the person in charge of this function, as the DP Manager although your actual title may differ.

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Record 1

QUESTIONNAIRE	1-4
INSTALLATION	5-6
CITY/COUNTY	7-10

PART I

COMPUTER OPERATIONS

PRIMARY SYSTEMS INVENTORY

1. For each mainframe and/or minicomputer, please fill in a row of the following table. In instances where resources (e.g., disk storage, tape drives or terminals attached) are used by more than one machine, please assign the resources to only one machine

MANUFACTURER (e.g., IBM, DEC)	MODEL (e.g., 4341, 780)	OPERATING SYSTEM (e.g., VM/CMS, VMS)	MAIN MEMORY IN MEGABYTES	DISK STORAGE IN GIGABYTES	NUMBER OF TAPE DRIVES	NUMBER OF TERMINALS ATTACHED	
1.							11-24
2.							25-38
3.							39-52
4.							53-66
5.							Record 2 11-24
6.							25-38
7.							39-52
8.							53-66
9.							Record 3 11-24
10.							25-38

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2

2. For each peripheral device listed below, please provide the total number connected to the primary systems listed in question 1. (ENTER TOTAL NUMBER OF EACH; IF NONE, ENTER '0'.) Record 4

A. Color terminals	I. Keypunch machines	11-15
B. Graphics terminals	J. Paper tape readers	16-20
C. Line printers	K. Paper tape punches	21-24
D. Laser printers	L. Key-to-tape devices	25-28
E. Multi-color printers	M. Key-to-disk devices	29-32
F. Plotters	N. Magnetic-ink character readers	33-36
G. Card readers	O. Optical character readers	37-40
H. Card punches	P. Dedicated Teleprocessor, (e.g., terminal concentrator, data switch)	41-44

3. How many elapsed hours per week are one or more computers at the installation generally operational? (ENTER NUMBER OF HOURS; TOTAL HOURS FOR A WEEK ARE 168 HOURS)

Total number of elapsed hours = 45-47

SYSTEM UTILITIES INVENTORY

4. Please indicate whether your installation currently uses the following system utilities, and if so, the name(s) of the system(s) used. (CIRCLE ONE NUMBER IN EACH ROW.)

	Yes	No	
A. Data Base Management System(s) (e.g., IMS, DM-4)	1	2	48
Name(s) of systems: ______			
B. Application Development Tools (e.g., COBOL generator)	1	2	49
Name(s) of systems: ______			
C. General Simulation Systems (e.g., SIMULA, GPSS)	1	2	50
Name(s) of systems: ______			
D. Teleprocessing Systems (e.g., TSO)	1	2	51
Name(s) of systems: ______			
E. Fourth generation Languages (e.g., FOCUS, RAMIS, SAS, MARK V)	1	2	52
Name(s) of systems: ______			

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PART II. APPLICATIONS DEVELOPMENT

SOFTWARE DEVELOPMENT TECHNIQUES

Record 4

5. Please indicate which of the following software development techniques are used by your in-house system development personnel. (CIRCLE ONE NUMBER IN EACH ROW.)

Technique:	Yes	No	
A. Chief programmer teams	1	2	53
B. Structured analysis	1	2	54
C. Structured design	1	2	55
D. Structured programming	1	2	56
E. Walk-throughs, inspections	1	2	57
F. Prototyping before regular development	1	2	58
G. Application generators	1	2	59
H. Formal life-cycle definitions	1	2	60

APPLICATIONS DEVELOPMENT LANGUAGES

6. What percent of your applications are in each of the following programming languages? (ENTER PERCENT IN EACH ROW; IF NONE ENTER '0'.)

Record 5

	Percent of Applications	
A. Assembly Language	☐☐☐	11-13
B. COBOL	☐☐☐	14-16
C. FORTRAN	☐☐☐	17-19
D. PL/1	☐☐☐	20-22
E. RPG	☐☐☐	23-25
F. BASIC	☐☐☐	26-28
G. ALGOL	☐☐☐	29-31
H. "C"	☐☐☐	32-34

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7. Which programming language is being used for <u>most</u> of the applications now being developed? (CIRCLE <u>ONE</u> NUMBER ONLY.) Record 5

Assembly Language	01	
COBOL	02	
FORTRAN	03	
PL/1	04	35-36
RPG	05	
BASIC	06	
ALGOL	07	
C	08	
OTHER (SPECIFY)	09	

8. Do you use a computer to model or simulate any government operations, such as simulation of sanitation truck routing, patrol car routing, or revenue/forecasting modeling? (CIRCLE ONE NUMBER.)

Yes	1	
No	2	37

9. Do you have a capability for linking data coded on the basis of one geographic base (e.g., address), to other bases, (e.g., census tract or land parcel)? (CIRCLE ONE NUMBER.)

Yes	1	
No	2	38

PROGRAMMER ACTIVITY, TRAINING AND EXPERIENCE

10. In the last year, how many formal visits have been made to your installation by managers, programmers, or analysts of other governmental entities? (ENTER NUMBER.)

Number of visits = ☐☐ 39-40

11. In the last year, how many outside EDP courses, commercial seminars, or training institutes were provided for your analysts and programmers? (ENTER NUMBER.)

Number of outside courses = ☐☐ 41-42

12. Please list the number of programmers and analysts on your staff within each of the following experience categories. (PLEASE MAKE BEST ESTIMATE WITHOUT GOING TO PERSONNEL RECORDS.) (ENTER NUMBER IN EACH ROW)

Years of experience:	Number of Analysts and Programmers	
A. 0-2 years	☐☐	43-44
B. 3-5 years	☐☐	45-46
C. 6-10 years	☐☐	47-48
D. Over 10 years	☐☐	49-50

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13. Please estimate the percent of overall programmer and system analyst staff time *currently devoted* to each of the activities listed below. (ENTER APPROXIMATE PERCENT IN EACH ROW; THE TOTAL SHOULD SUM TO 100%.) Record 6

Activity:	Percent of Staff Time	
A. New application design and development	☐☐☐	11-13
B. Investigation and choice of packaged applications	☐☐☐	14-16
C. Maintaining application programs	☐☐☐	17-19
D. Preparing documentation	☐☐☐	20-22
E. Training	☐☐☐	23-25
F. Other (PLEASE SPECIFY) ______	☐☐☐	26-28
	Total = 100%	

14. Please estimate the percent of overall programmer and system analyst staff time *you would prefer be devoted* to each of the activities listed below. (ENTER APPROXIMATE PERCENT IN EACH ROW; THE TOTAL SHOULD SUM TO 100%.)

Activity:	Percent of Staff Time	
A. New application design and development	☐☐☐	29-31
B. Investigation and choice of packaged applications	☐☐☐	32-34
C. Maintaining application programs	☐☐☐	35-37
D. Preparing documentation	☐☐☐	38-40
E. Training	☐☐☐	41-43
F. Other (PLEASE SPECIFY) ______	☐☐☐	44-46
	Total = 100%	

15. On average, what would you estimate is the percent of time that programmers and analysts in your installation spend communicating with users? (ENTER PERCENT)

Percent of time spent with users = ☐☐☐ % 47-49

16. Given your current personnel, by how much could you expand user services? (CIRCLE ONE NUMBER.) 50

- Cannot expand 1
- Current staff could absorb a **minor increase** in user services 2
- Current staff could absorb a **major increase** in user services 3

17. At current staff levels, approximately how much of a backlog in application development does your installation now have? (CIRCLE ONE NUMBER.) 51

- None 1
- 6 months or less 2
- Between 6 months and a year 3
- Between 1 and 2 years 4
- 2 years or more 5

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Record 6

18. What portion of applications running at your installation are based on programs written by your own programmers? (CIRCLE ONE NUMBER.)

None	1	
Few	2	
About half	3	52
Most	4	
All	5	

SOURCES OF APPLICATIONS

19. Please indicate whether or not each of the sources listed below has designed computer applications at your installation in the last two years. (CIRCLE ONE NUMBER IN EACH ROW)

	Have Designed Applications	Have Not Designed Applications	
A. This data processing installation	1	2	53
B. User departments	1	2	54
C. Outside consulting firm	1	2	55
D. Private service bureau	1	2	56
E. Commercial software vendor or firm	1	2	57
F. Hardware vendor	1	2	58
G. Designed by other local government (transferred here)	1	2	59

20. Please indicate whether or not each of the sources listed below has programmed computer applications at your installation in the last two years. (CIRCLE ONE NUMBER IN EACH ROW.)

	Have Programmed Applications	Have Not Programmed Applications	
A. This data processing installation	1	2	60
B. User departments	1	2	61
C. Outside consulting firm	1	2	62
D. Private service bureau	1	2	63
E. Commercial software vendor or firm	1	2	64
F. Hardware vendor	1	2	65
G. Designed by other local government (transferred here)	1	2	66

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APPLICATION TRANSFER: OPERATIONS

Record 7

21. Since 1980, has this installation transferred in any operations applications, (e.g., personnel, accounting, budgeting, fleet management applications) from another government or public interest group? (CIRCLE ONE NUMBER.)

Yes 1

No (CIRCLE NUMBER, SKIP TO Q.25) 2 11

22. Please list the operations applications transferred to this government since 1980 and the source of the applications.

Operations applications transferred in:	Source:	
A. ______	______	12
B. ______	______	13
C. ______	______	14
D. ______	______	15
E. ______	______	16

23. Overall, how important were each of the following reasons in your decision to transfer in applications rather than developing them in-house? (CIRCLE ONE NUMBER IN EACH ROW.)

	Not Important	Somewhat Important	Very Important	
A. Cost savings	1	2	3	17
B. Applications would be operational faster	1	2	3	8
C. Applications were too sophisticated to be developed in-house	1	2	3	19
D. Because of federal or state mandated reporting requirements	1	2	3	20
E. They were specifically requested by users	1	2	3	21

24. In general, were any of the following problems encountered in the transfer in of these applications? (CIRCLE ONE NUMBER IN EACH ROW.)

	No Problem	Minor Problem	Major Problem	
A. Poor documentation for management	1	2	3	22
B. Poor documentation for systems programmers and analysts	1	2	3	23
C. Needed extensive modification for user operations	1	2	3	24
D. Needed extensive modification to run on our computer system	1	2	3	25
E. Other (SPECIFY) ______	1	2	3	26

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Record 7

APPLICATION TRANSFER: PLANNING AND MANAGEMENT

25. Since 1980, has this installation transferred in any *planning and management* applications, (e.g., statistical packages, forecasting models, fire station locators, etc.) from another government or public interest group? (CIRCLE ONE NUMBER.)

Yes 1

No (CIRCLE NUMBER, SKIP TO Q.29) 2 27

26. Please list the planning and management applications transferred to this government since 1980 and the source of the applications.

Planning and Management applications transferred in:	Source:	
A. ______________________	______________________	28
B. ______________________	______________________	29
C. ______________________	______________________	30
D. ______________________	______________________	31
E. ______________________	______________________	32

27. Overall, how important were each of the following reasons in your decision to *transfer in* planning or management applications rather than developing them in-house? (CIRCLE ONE NUMBER IN EACH ROW.)

	Not Important	Somewhat Important	Very Important	
A. Cost savings	1	2	3	33
B. Applications would be operational faster	1	2	3	34
C. Applications were too sophisticated to be developed in-house	1	2	3	35
D. Because of federal or state mandated reporting requirements	1	2	3	36
E. They were specifically requested by users	1	2	3	37

28. In general, were any of the following problems encountered in the transfer of planning or management applications? (CIRCLE ONE NUMBER IN EACH ROW.)

	No Problem	Minor Problem	Major Problem	
A. Poor documentation for management	1	2	3	38
B. Poor documentation for systems programmers and analysts	1	2	3	39
C. Needed extensive modification for user operations	1	2	3	40
D. Needed extensive modification to run on our computer system	1	2	3	41
E. Other (SPECIFY) ______________	1	2	3	42

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APPLICATION TRANSFER TO OTHER GOVERNMENTS

Record 7

29. Since 1980, has this installation <u>transferred out</u> any automated applications to other local governments? (CIRCLE ONE NUMBER.)

Yes 1
No (CIRCLE NUMBER AND SKIP TO Q. 32) .... 2 — 43

30. Please list the applications transferred *from* this government since 1980, and where the applications were transferred to:

	Applications Transferred out:	Destination:	
A.			44
B.			45
C.			46
D.			47
E.			48

31. In general, did you experience any problems while transferring out these applications?

Yes 1
No .... 2 — 49

IF YES; Please specify the problem:

____
____
____

TURNKEY SYSTEMS

32. Please list the turnkey systems (software/computer packages) currently operated by your installation.

	Vendor	System Name	Major Function	Year Acquired	
A.				1 9 _ _	50-51
B.				1 9 _ _	52-53
C.				1 9 _ _	54-55
D.				1 9 _ _	56-57
E.				1 9 _ _	58-59

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PART III. APPLICATIONS INVENTORY

Please complete the following inventory of computer applications. The inventory replicates and extends the inventory completed by your government in 1975. The completed inventory, in combination with those of other local governments, will provide two types of information. First, they will indicate the extent of computing applications across all functional areas of government, at present. Second, comparisons with the inventories completed in 1975 will indicate the pace and direction of automation efforts during the intervening decade. This information will help us better understand the future role of computing in local governments.

Since comparative analysis is important to our research, we ask that you try to fit all applications in the specific categories provided. We made the categories as comprehensive as space permitted, however, additional space is provided at the end of each functional area for you to add items which are impossible to fit in the categories provided. Below is an index of functional areas (including page numbers) to assist you in completing this inventory.

FUNCTIONAL AREAS

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PUBLIC SAFETY	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line?		Is it in a DBMS?		If the application is part of a larger or integrated system, please name system	
				Yes	No	Yes	No		Record 8
A. POLICE PROTECTION									
Criminal Investigations:									
1. Field interview reports	1	2	3	1	2	1	2		11-13
2. Crime investigation support system	1	2	3	1	2	1	2		
3. Intelligence compilation	1	2	3	1	2	1	2		
4. Modus operandi (criminal patterns)	1	2	3	1	2	1	2		
5. Criminal offense	1	2	3	1	2	1	2		
6. Known offenders	1	2	3	1	2	1	2		
7. Arrest records	1	2	3	1	2	1	2		
8. Criminal history	1	2	3	1	2	1	2		
9. Jail booking, custody/population	1	2	3	1	2	1	2		
~~10.Juvenile criminal offense~~	~~1~~	~~2~~	~~3~~	~~1~~	~~2~~	~~1~~	~~2~~		
11.Fingerprint	1	2	3	1	2	1	2		
12.Criminal/suspect name/alias	1	2	3	1	2	1	2		
13.NCIC reporting/inquiry system	1	2	3	1	2	1	2		
14.Uniform Crime Reporting (UCR) System	1	2	3	1	2	1	2		
15.Other crime reporting system	1	2	3	1	2	1	2		
Traffic/Parking:									
16.Parking ticket file	1	2	3	1	2	1	2		
17.Traffic accident file	1	2	3	1	2	1	2		
18.Traffic violations	1	2	3	1	2	1	2		62-64
Police Operations:									Record 9
19.Wants/warrants	1	2	3	1	2	1	2		11-13
20.Missing persons	1	2	3	1	2	1	2		
21.Stolen vehicles	1	2	3	1	2	1	2		
22.Stolen property	1	2	3	1	2	1	2		
23.Dispatching records	1	2	3	1	2	1	2		
24.Computer-aided dispatching system	1	2	3	1	2	1	2		
25.Automated vehicle monitoring system	1	2	3	1	2	1	2		
26.Automated vehicle navigation system	1	2	3	1	2	1	2		
27.Automated emergency communications (911) system	1	2	3	1	2	1	2		
28.Civil offenses	1	2	3	1	2	1	2		
29.Firearms registration	1	2	3	1	2	1	2		
30.Motor vehicle registration	1	2	3	1	2	1	2		
31.Bicycle registration	1	2	3	1	2	1	2		
32.Police permits (e.g., parades)	1	2	3	1	2	1	2		50-52

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PUBLIC SAFETY	For each application listed, please indicate its current status: Now Operational	Planned within two years	Not Operational, Not Planned	For each application that is now operational, please answer the following THREE questions: Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	
									Record 10
Police Planning and Development:									
33. Law Enforcement Manpower Resources Allocation System (LEMRAS)	1	2	3	1	2	1	2		11-13
34. Other manpower allocation system	1	2	3	1	2	1	2		
35. Case management system	1	2	3	1	2	1	2		
36. Service data (type of call, location, time, response time)	1	2	3	1	2	1	2		
37. Burglar alarm monitoring system	1	2	3	1	2	1	2		
Police Administration (Answer Only If Separate From City's General Applications):									
38. Vehicle maintenance records	1	2	3	1	2	1	2		
39. Payroll preparation and accounting	1	2	3	1	2	1	2		
40. General accounting	1	2	3	1	2	1	2		
41. Cost accounting	1	2	3	1	2	1	2		
42. Police employee records	1	2	3	1	2	1	2		
Other Police Files/Applications:									
43.	1	2	3	1	2	1	2		
44.	1	2	3	1	2	1	2		44-46
B. FIRE PROTECTION									Record 11
Fire Prevention and Inspection:									
1. Building description records	1	2	3	1	2	1	2		11-13
2. Building inspection records	1	2	3	1	2	1	2		
3. Fire hydrant location	1	2	3	1	2	1	2		
Fire operations:									
4. Fire dispatching records	1	2	3	1	2	1	2		
5. Computer-aided dispatching system	1	2	3	1	2	1	2		
6. Automated vehicle navigation system	1	2	3	1	2	1	2		
7. Automated emergency communications (911) system	1	2	3	1	2	1	2		
8. Fire investigation reports	1	2	3	1	2	1	2		
Fire Planning and Development:									
9. Fire station locator	1	2	3	1	2	1	2		
10. Other analysis to determine fire station location	1	2	3	1	2	1	2		
11. Fire apparatus inventory	1	2	3	1	2	1	2		
12. Fire vehicle inventory	1	2	3	1	2	1	2		44-46

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PUBLIC SAFETY	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record 12
Fire Planning and Development (Continued):									
13. Uniform Fire Incident Reporting System (UFIRS)	1	2	3	1	2	1	2		11-13
14. Other fire incident reporting systems	1	2	3	1	2	1	2		
15. Service data (type of call, location, time, response time)	1	2	3	1	2	1	2		
16. Manpower allocation and distribution	1	2	3	1	2	1	2		
Fire Administration (Answer Only If Separate From City's General Applications):									
17. Vehicle maintenance records	1	2	3	1	2	1	2		
18. Payroll preparation and accounting	1	2	3	1	2	1	2		
19. General accounting	1	2	3	1	2	1	2		
20. Cost accounting	1	2	3	1	2	1	2		
21. Fire employee records	1	2	3	1	2	1	2		
Other Fire Files/Applications:									
22.	1	2	3	1	2	1	2		
23.	1	2	3	1	2	1	2		41-43
C. COURTS									Record 13
Juvenile Court:									
1. Court case disposition records	1	2	3	1	2	1	2		11-13
2. Juvenile probation records	1	2	3	1	2	1	2		
3. Detention records	1	2	3	1	2	1	2		
Civil/Criminal Courts:									
4. Court room calendars and scheduling	1	2	3	1	2	1	2		
5. Court docketing	1	2	3	1	2	1	2		
6. Assignment of attorneys	1	2	3	1	2	1	2		
7. Jury selection/management	1	2	3	1	2	1	2		
8. Witness subpoenas	1	2	3	1	2	1	2		
9. Friend of the court records	1	2	3	1	2	1	2		
10. Court disposition	1	2	3	1	2	1	2		
11. Probation records	1	2	3	1	2	1	2		
12. Detention records	1	2	3	1	2	1	2		
13. Marriage & divorce records	1	2	3	1	2	1	2		
14. Fine, collateral and bail collection	1	2	3	1	2	1	2		
15. Child support records	1	2	3	1	2	1	2		53-55

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PUBLIC SAFETY	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record 14
Civil/Criminal Courts (Continued):									
16. Alimony records	1	2	3	1	2	1	2		11-13
17. Alcohol Safety Action Project (ASAP)	1	2	3	1	2	1	2		
18. Other court tracking system	1	2	3	1	2	1	2		
19. Prosecution Management Information System (PROMIS)	1	2	3	1	2	1	2		
20. Other case management information system	1	2	3	1	2	1	2		
Court Administration (Answer Only If Separate From City's General Applications):									
21. Payroll preparation and accounting	1	2	3	1	2	1	2		
22. General accounting	1	2	3	1	2	1	2		
23. Cost accounting	1	2	3	1	2	1	2		
Other Court Files/Applications:									
24.	1	2	3	1	2	1	2		
25.	1	2	3	1	2	1	2		
26.	1	2	3	1	2	1	2		41-43
D. EMERGENCY PREPAREDNESS									Record 15
1. Public shelter location	1	2	3	1	2	1	2		11-13
2. Public shelter supply inventory	1	2	3	1	2	1	2		
3. Manpower roster and allocation	1	2	3	1	2	1	2		
4. Evacuation planning system	1	2	3	1	2	1	2		
5. Automated emergency communications (911) system	1	2	3	1	2	1	2		
6. Severe weather monitor	1	2	3	1	2	1	2		
Other Files/Applications:									
7.	1	2	3	1	2	1	2		
8.	1	2	3	1	2	1	2		
E. EMERGENCY MEDICAL SERVICES									
Operations:									
1. Dispatching	1	2	3	1	2	1	2		
2. Computer-aided dispatching system	1	2	3	1	2	1	2		
3. Automated emergency communications (911) system	1	2	3	1	2	1	2		41-43

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PUBLIC SAFETY	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Opera-tional	Planned within two years	Not Opera-tional, Not Planned	Is it operating on-line?		Is it in a DBMS?		If the application is part of a larger or integrated system, please name system	Record 15
				Yes	No	Yes	No		
EMS Administration :									
4. Patient billing	1	2	3	1	2	1	2		44-46
5. Service data	1	2	3	1	2	1	2		
6. Manpower allocation system	1	2	3	1	2	1	2		
7. Vehicle maintenance	1	2	3	1	2	1	2		
8. Vehicle/equipment inventory	1	2	3	1	2	1	2		
Other EMS Files/Applications:									
9.	1	2	3	1	2	1	2		
10.	1	2	3	1	2	1	2		62-64

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FINANCE/ ADMINISTRATION	For each application listed, please indicate its current status: Now Operational	Planned within two years	Not Operational, Not Planned	For each application that is now operational, please answer the following THREE questions: Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	
									Record 16
F. ACCOUNTING									
1. General accounting	1	2	3	1	2	1	2		11-13
2. Cost accounting	1	2	3	1	2	1	2		
3. Bonded debt and interest accounting (debt service)	1	2	3	1	2	1	2		
4. Fixed assets	1	2	3	1	2	1	2		
5. Check preparing and issuing	1	2	3	1	2	1	2		
6. Check reconciliation	1	2	3	1	2	1	2		
7. Payroll preparation and accounting	1	2	3	1	2	1	2		
8. Retirement and pension records	1	2	3	1	2	1	2		
9. Internal audit reports	1	2	3	1	2	1	2		
10. Insurance records	1	2	3	1	2	1	2		
Other Accounting Files/Applications									
11.	1	2	3	1	2	1	2		
12.	1	2	3	1	2	1	2		44-46
G. TREASURY AND COLLECTION									Record 17
1. Property tax billing & collection	1	2	3	1	2	1	2		11-13
2. Nonproperty tax billing & collection (i.e., income, sales, utilities, etc.)	1	2	3	1	2	1	2		
3. City income tax	1	2	3	1	2	1	2		
4. Delinquent tax records	1	2	3	1	2	1	2		
5. Special assessment tax records	1	2	3	1	2	1	2		
6. Federal and State grant file(s)	1	2	3	1	2	1	2		
7. Cash management/cash flow analysis	1	2	3	1	2	1	2		
8. Investment/portfolio management	1	2	3	1	2	1	2		
9. Municipal bond records	1	2	3	1	2	1	2		
10. Securities/funds records and interest reports	1	2	3	1	2	1	2		
11. Preparation of vouchers/warrants for city funds	1	2	3	1	2	1	2		
12. Business license billing	1	2	3	1	2	1	2		
Other Treasury/Collection Applications									
13.	1	2	3	1	2	1	2		
14.	1	2	3	1	2	1	2		50-52

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FINANCE/ ADMINISTRATION	For each application listed, please indicate its current status: Now Operational	Planned within two years	Not Operational, Not Planned	For each application that is now operational, please answer the following THREE questions: Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record:
H. ASSESSMENT AND RECORDING									
Property Records:									
1. Real property records	1	2	3	1	2	1	2		11-13
2. Personal property records	1	2	3	1	2	1	2		
3. Property/tax (parcel) location and legal identification	1	2	3	1	2	1	2		
4. Tax rate establishment	1	2	3	1	2	1	2		
5. Exemption records	1	2	3	1	2	1	2		
Market Monitoring:									
6. Property sales listing	1	2	3	1	2	1	2		
7. Sales ratio analysis	1	2	3	1	2	1	2		
Property Valuation:									
8. Calculation of real property value, assessing	1	2	3	1	2	1	2		
9. Regression analysis for residential property appraisal	1	2	3	1	2	1	2		
10. Regression analysis for non-residential property appraisal	1	2	3	1	2	1	2		
Property Listing:									
11. Assessment or tax roll	1	2	3	1	2	1	2		
12. Property ownership list	1	2	3	1	2	1	2		
Other Assessment Applications:									
13.	1	2	3	1	2	1	2		
14.	1	2	3	1	2	1	2		50-52
I. BUDGETING AND MANAGEMENT									Record
Operations:									
1. Expenditure forecasting	1	2	3	1	2	1	2		11-13
2. Revenue forecasting	1	2	3	1	2	1	2		
3. Budget preparation	1	2	3	1	2	1	2		
4. Program budget preparation	1	2	3	1	2	1	2		
5. Program structure related to line-item budget	1	2	3	1	2	1	2		
6. Budget monitoring system	1	2	3	1	2	1	2		
7. Budgetary and financial analysis	1	2	3	1	2	1	2		
8. Productivity measurement	1	2	3	1	2	1	2		
9. Program effectiveness measurement	1	2	3	1	2	1	2		35-37

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FINANCE/ ADMINISTRATION	For each application listed, please indicate its current status: Now Operational	Planned within two years	Not Operational, Not Planned	For each application that is now operational, please answer the following THREE questions: Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record 20
Budgeting and Management Operations (Continued):									
10. Cost of services analysis	1	2	3	1	2	1	2		11-13
11. Community Analysis Program (CAP)	1	2	3	1	2	1	2		
Decision Support/Operations Research:									
12. Vehicle routing (e.g., buses, sanitation routing	1	2	3	1	2	1	2		
13. Personnel routing (e.g., meter reader, subpoena server)	1	2	3	1	2	1	2		
14. Facility locator	1	2	3	1	2	1	2		
15. Administrative redistricting/workload balancing (e.g., caseloads, inspections)	1	2	3	1	2	1	2		
16. Political redistricting	1	2	3	1	2	1	2		
Other Budget/Management Files:									
17.	1	2	3	1	2	1	2		
18.	1	2	3	1	2	1	2		35-37
J. PURCHASING AND INVENTORY									Record 21
Purchasing:									
1. Requisition records	1	2	3	1	2	1	2		11-13
2. Bid records	1	2	3	1	2	1	2		
3. Purchase order records	1	2	3	1	2	1	2		
4. Specification records	1	2	3	1	2	1	2		
5. Vendor lists	1	2	3	1	2	1	2		
6. Contracts	1	2	3	1	2	1	2		
Inventory:									
7. Central stores inventory	1	2	3	1	2	1	2		
8. Capital/office equipment	1	2	3	1	2	1	2		
9. Property furnishings	1	2	3	1	2	1	2		
10. Commodity price records	1	2	3	1	2	1	2		
Other Purchasing/Inventory Files:									
11.	1	2	3	1	2	1	2		
12.	1	2	3	1	2	1	2		
K. PERSONNEL									
1. Position control (budgeted vs. actual)	1	2	3	1	2	1	2		
2. Position classification listing	1	2	3	1	2	1	2		
3. Application/recruiting	1	2	3	1	2	1	2		53-55

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FINANCE AND ADMINISTRATION	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:				
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line?		Is it in a DBMS?		If the application is part of a larger or integrated system, please name system
				Yes	No	Yes	No	
Personnel (Continued):								
4. Test records and scoring	1	2	3	1	2	1	2	
5. Employee history records	1	2	3	1	2	1	2	
6. Retirement and pension records	1	2	3	1	2	1	2	
7. Ethnic salary survey	1	2	3	1	2	1	2	
8. Affirmative Action reports	1	2	3	1	2	1	2	
9. Credit union	1	2	3	1	2	1	2	
10. Insurance records	1	2	3	1	2	1	2	
11. Employee mailing lists	1	2	3	1	2	1	2	
12. Employee telephone directory	1	2	3	1	2	1	2	
13. Comparative wages and benefits from other governments	1	2	3	1	2	1	2	
14. Collective bargaining, labor negotiations support (e.g., forecasting impacts of proposed salary changes)	1	2	3	1	2	1	2	
Other Personnel Files:								
15.	1	2	3	1	2	1	2	
16.	1	2	3	1	2	1	2	

Record 22

11-13

47-49

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GENERAL GOVERNMENT	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line? Yes	Is it operating on-line? No	Is it in a DBMS? Yes	Is it in a DBMS? No	If the application is part of a larger or integrated system, please name system	Record 23
L. DATA PROCESSING									
1. Computer utilization records	1	2	3	1	2	1	2		11-13
2. Peripheral equipment utilization records	1	2	3	1	2	1	2		
3. Application requirements	1	2	3	1	2	1	2		
4. Job accounting	1	2	3	1	2	1	2		
5. Customer billing	1	2	3	1	2	1	2		
6. Program debugging routines	1	2	3	1	2	1	2		
7. System program maintenance	1	2	3	1	2	1	2		
8. System performance monitor	1	2	3	1	2	1	2		
9. Program editor	1	2	3	1	2	1	2		
10. Program documentation system	1	2	3	1	2	1	2		
11. Capacity analysis	1	2	3	1	2	1	2		
12. Tape management	1	2	3	1	2	1	2		
13. Data dictionary	1	2	3	1	2	1	2		
14. Data inventory	1	2	3	1	2	1	2		
15. Database management system	1	2	3	1	2	1	2		
16. Teleprocessing system	1	2	3	1	2	1	2		
17. Information Center	1	2	3	1	2	1	2		
Other Data Processing Files:									
18.	1	2	3	1	2	1	2		
19.	1	2	3	1	2	1	2		65-67
M. OFFICE SYSTEMS									Record 24
1. Calendaring	1	2	3	1	2	1	2		11-13
2. Electronic mail	1	2	3	1	2	1	2		
3. Word processing	1	2	3	1	2	1	2		
4. Text editing/text formatting	1	2	3	1	2	1	2		
5. Spread sheet analysis	1	2	3	1	2	1	2		
6. Statistical analysis	1	2	3	1	2	1	2		
7. Programming	1	2	3	1	2	1	2		
8. Training	1	2	3	1	2	1	2		
9. Business charts and graphics	1	2	3	1	2	1	2		
10. In-house printing/publishing	1	2	3	1	2	1	2		
11. Videotext/teletext services	1	2	3	1	2	1	2		
12. Telephone line switching (PBX)	1	2	3	1	2	1	2		
13. Non-DP computer-oriented training	1	2	3	1	2	1	2		
Other Office Systems Files:									
14.	1	2	3	1	2	1	2		
15.	1	2	3	1	2	1	2		53-55

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GENERAL GOVERNMENT	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record 25
N. GEOPROCESSING									
Geographic Information Systems:									
1. Street Address Conversion System (SACS)	1	2	3	1	2	1	2		11-13
2. Address Coding Guide (ACG)	1	2	3	1	2	1	2		
3. Master address directory	1	2	3	1	2	1	2		
4. Geographic data base (e.g. GBF/DIME)	1	2	3	1	2	1	2		
5. Address Matching (e.g., ADMATCH)	1	2	3	1	2	1	2		
Mapping and Graphics Applications:									
6. Thematic, areal, statistical mapping (e.g., SYNMAP, GRIDS)	1	2	3	1	2	1	2		
7. Parcel level mapping (e.g., INTERGRAPH, SYNERCOM)	1	2	3	1	2	1	2		
Other Geoprocessing Files:									
8.	1	2	3	1	2	1	2		
9.	1	2	3	1	2	1	2		
O. PUBLIC INFORMATION									
1. Citizen complaint processing	1	2	3	1	2	1	2		
2. Media mailing list	1	2	3	1	2	1	2		
3. Computerized citizen/tourist public information system	1	2	3	1	2	1	2		
4. Govt. public events calendaring/listing	1	2	3	1	2	1	2		
Other Public Information Files:									
5	1	2	3	1	2	1	2		
6.	1	2	3	1	2	1	2		53-55
P. PUBLIC BUILDINGS									Record 26
1. Building identification and location	1	2	3	1	2	1	2		11-13
2. Building maintenance record/scheduling	1	2	3	1	2	1	2		
3. Building construction records	1	2	3	1	2	1	2		
4. Room reservations and scheduling	1	2	3	1	2	1	2		
5. Space utilization records	1	2	3	1	2	1	2		
6. Energy use monitoring/control system	1	2	3	1	2	1	2		
7. Security monitoring system	1	2	3	1	2	1	2		
Other Public Buildings Files:									
8.	1	2	3	1	2	1	2		
9.	1	2	3	1	2	1	2		35-37

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GENERAL GOVERNMENT	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line?		Is it in a DBMS?		If the application is part of a larger or integrated system, please name system	Record 27
				Yes	No	Yes	No		
Q. CLERK/RECORDER									
1. Deed records	1	2	3	1	2	1	2		11-13
2. Land, plat records	1	2	3	1	2	1	2		
3. Ordinance records	1	2	3	1	2	1	2		
Other Clerk/Recorder Files:									
4.	1	2	3	1	2	1	2		
5.	1	2	3	1	2	1	2		
R. CENTRAL GARAGE/ MOTOR POOL									
1. Motor vehicle equipment/parts	1	2	3	1	2	1	2		
2. Motor vehicle maintenance records	1	2	3	1	2	1	2		
3. Motor vehicle utilization records	1	2	3	1	2	1	2		
4. Gas consumption records	1	2	3	1	2	1	2		
5. Fuel dispensation/accounting/ monitoring system	1	2	3	1	2	1	2		
6. Fleet management information system	1	2	3	1	2	1	2		
Other Central Garage Files:									
7.	1	2	3	1	2	1	2		
8.	1	2	3	1	2	1	2		
S. OTHER GENERAL GOVERNMENT									
1.	1	2	3	1	2	1	2		
2.	1	2	3	1	2	1	2		
3.	1	2	3	1	2	1	2		
4.	1	2	3	1	2	1	2		59-61

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COMMUNITY DEVELOPMENT, PUBLIC WORKS, AND UTILITIES	For each application listed, please indicate its current status: Now Operational	Planned within two years	Not Operational, Not Planned	For each application that is now operational, please answer the following THREE questions: Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	
									Record 28
T. PLANNING AND ZONING									
Land Use and Zoning:									
1. Land use inventory	1	2	3	1	2	1	2		11-13
2. Zoning ordinances	1	2	3	1	2	1	2		
3. Zoning inspections	1	2	3	1	2	1	2		
4. Subdivision inspection	1	2	3	1	2	1	2		
5. Infrastructure/capital improvements, planning and budgeting	1	2	3	1	2	1	2		
6. Natural resource inventory planning and management	1	2	3	1	2	1	2		
7. Fiscal impact/cost-revenue analysis and development	1	2	3	1	2	1	2		
Social Indicators & Community Analysis									
8. U.S. Census data (e.g., population, housing, government)	1	2	3	1	2	1	2		
9. Demographic data other than U.S. Census (e.g., local surveys)	1	2	3	1	2	1	2		
10. Labor force and employment data	1	2	3	1	2	1	2		
11. Industrial production data	1	2	3	1	2	1	2		
12. Commercial business activity & sales	1	2	3	1	2	1	2		
13. Neighborhood-oriented data (mix of socio-economic & demographic info)	1	2	3	1	2	1	2		47-49
Urban Development Models:									Record 29
14. Population	1	2	3	1	2	1	2		11-13
15. Land use	1	2	3	1	2	1	2		
16. Transportation and traffic	1	2	3	1	2	1	2		
17. Economic	1	2	3	1	2	1	2		
18. Housing	1	2	3	1	2	1	2		
19. Development costs	1	2	3	1	2	1	2		
Other Planning/Zoning Files:									
20.	1	2	3	1	2	1	2		
21.	1	2	3	1	2	1	2		
U. HOUSING, URBAN RENEWAL & COMMUNITY DEVELOPMENT									
Housing Programs:									
1. Housing survey data	1	2	3	1	2	1	2		
2. Public housing occupancy records	1	2	3	1	2	1	2		
3. Housing construction scheduling	1	2	3	1	2	1	2		
4. Housing maintenance scheduling	1	2	3	1	2	1	2		
5. Cost accounting	1	2	3	1	2	1	2		47-49

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COMMUNITY DEVELOPMENT, PUBLIC WORKS, AND UTILITIES	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record 30
Urban Renewal:									
6. Relocation data	1	2	3	1	2	1	2		11-13
7. Construction scheduling	1	2	3	1	2	1	2		
8. Cost accounting	1	2	3	1	2	1	2		
9. Model cities information system	1	2	3	1	2	1	2		
10. Substandard structure reports	1	2	3	1	2	1	2		
11. Certificate of occupancy	1	2	3	1	2	1	2		
Community Development:									
12. Federal Community Development Block Grant monitoring	1	2	3	1	2	1	2		
13. Development project monitoring	1	2	3	1	2	1	2		
14. Federal/state home improvement loan administration	1	2	3	1	2	1	2		
Other Housing & Urban Renewal Files:									
15.	1	2	3	1	2	1	2		
16.	1	2	3	1	2	1	2		41-43
V. LICENSING AND CODE ENFORCEMENT									Record 31
Animal Control:									
1. Animal licenses	1	2	3	1	2	1	2		11-13
2. Code violation records	1	2	3	1	2	1	2		
3. Pound detention	1	2	3	1	2	1	2		
Business Licenses:									
4. Business license records	1	2	3	1	2	1	2		
5. Business license inspections	1	2	3	1	2	1	2		
6. Fictitious business name	1	2	3	1	2	1	2		
Business Permits and Inspections:									
7. Building permits (e.g., electrical, general)	1	2	3	1	2	1	2		
8. Safety licenses	1	2	3	1	2	1	2		
9. Building complaint records	1	2	3	1	2	1	2		
10. Building inspection records/scheduling	1	2	3	1	2	1	2		
11. Housing code enforcement	1	2	3	1	2	1	2		
Other Licensing/Code Enforcement Files:									
12.	1	2	3	1	2	1	2		
13.	1	2	3	1	2	1	2		47-49

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COMMUNITY DEVELOPMENT, PUBLIC WORKS, AND UTILITIES	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line?		Is it in a DBMS?		If the application is part of a larger or integrated system, please name system	
				Yes	No	Yes	No		Record 32
W. ENGINEERING									
Design and Survey:									
1. Design requirements	1	2	3	1	2	1	2		11-13
2. Engineering design calculations	1	2	3	1	2	1	2		
3. Contract specifications	1	2	3	1	2	1	2		
4. Project status and scheduling	1	2	3	1	2	1	2		
5. Project cost accounting	1	2	3	1	2	1	2		
6. Right of way	1	2	3	1	2	1	2		
7. Land survey data	1	2	3	1	2	1	2		
8. Soil foundation analysis data	1	2	3	1	2	1	2		
9 Rainfall analysis	1	2	3	1	2	1	2		
10.Flood control inventory	1	2	3	1	2	1	2		
11.Computer-aided design system	1	2	3	1	2	1	2		
Maps:									
12.Engineering map identification	1	2	3	1	2	1	2		
13.Utility line location	1	2	3	1	2	1	2		
14.Map generation	1	2	3	1	2	1	2		
Other Engineering Files:									
15.	1	2	3	1	2	1	2		
16.	1	2	3	1	2	1	2		56-58
X. TRANSPORTATION									
Traffic Control and Engineering:									Record 33
1. Integrated traffic light control	1	2	3	1	2	1	2		11-13
2. Traffic control device inventory (e g signals, signs)	1	2	3	1	2	1	2		
3. Control device maintenance records/ scheduling/monitoring	1	2	3	1	2	1	2		
4. Control device construction records/ scheduling/monitoring	1	2	3	1	2	1	2		
5 Traffic flow data	1	2	3	1	2	1	2		
6. Traffic flow projections	1	2	3	1	2	1	2		
7. General traffic operations	1	2	3	1	2	1	2		
8. Signal timing simulation & optimization	1	2	3	1	2	1	2		
Transportation Planning:									
9. Land use and trip generation	1	2	3	1	2	1	2		
10.Network-based transit planning	1	2	3	1	2	1	2		
11.Impact estimation	1	2	3	1	2	1	2		41-43

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COMMUNITY DEVELOPMENT, PUBLIC WORKS, AND UTILITIES	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record 34
Transportation Systems:									
12.Car pool monitor	1	2	3	1	2	1	2		11-13
13.Mass transit management	1	2	3	1	2	1	2		
14.Vehicle scheduling and routing	1	2	3	1	2	1	2		
15.Ridership reporting	1	2	3	1	2	1	2		
16.Ridership revenue estimation	1	2	3	1	2	1	2		
17.Vehicle maintenance/scheduling	1	2	3	1	2	1	2		
18.Financial management	1	2	3	1	2	1	2		
Airports/Harbors:									
19.Facility utilization monitor	1	2	3	1	2	1	2		
20.Billing and collections	1	2	3	1	2	1	2		
Other Transportation Files:									
21.	1	2	3	1	2	1	2		
22.	1	2	3	1	2	1	2		41-43
Y. STREETS AND HIGHWAYS									Record 35
1. Streets and highways inventory/location	1	2	3	1	2	1	2		11-13
2. Street names inventory/guide	1	2	3	1	2	1	2		
3. Street lighting inventory/location	1	2	3	1	2	1	2		
4. Maintenance records/scheduling/ monitoring	1	2	3	1	2	1	2		
5. Construction records/scheduling/ monitoring	1	2	3	1	2	1	2		
6. Maintenance/construction equipment inventory	1	2	3	1	2	1	2		
7. Cost accounting	1	2	3	1	2	1	2		
Other Streets & Highways Files:									
8.	1	2	3	1	2	1	2		
9.	1	2	3	1	2	1	2		
Z. SANITATION									
Solid Waste Disposal:									
1. Equipment and manpower allocation	1	2	3	1	2	1	2		
2. Refuse collection scheduling	1	2	3	1	2	1	2		
3. Street cleaning/snow removal	1	2	3	1	2	1	2		
4. Landfill control	1	2	3	1	2	1	2		
5. Solid waste billing	1	2	3	1	2	1	2		
6. Solid waste accounting	1	2	3	1	2	1	2		
7. Customer inquiry	1	2	3	1	2	1	2		56-58

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COMMUNITY DEVELOPMENT, PUBLIC WORKS, AND UTILITIES	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record 36
Liquid Waste Disposal:									
8. Sewer line inventory, location	1	2	3	1	2	1	2		11-13
9. Maintenance records/scheduling/ monitoring	1	2	3	1	2	1	2		
10. Inspection records	1	2	3	1	2	1	2		
11. Equipment and manpower allocation	1	2	3	1	2	1	2		
12. Construction records/scheduling/ monitoring	1	2	3	1	2	1	2		
13. Sewage treatment records	1	2	3	1	2	1	2		
14. Cost accounting	1	2	3	1	2	1	2		
15. Customer inquiry records	1	2	3	1	2	1	2		
Other Sanitation Files:									
16.	1	2	3	1	2	1	2		
17.	1	2	3	1	2	1	2		38-40
AA. WATER SUPPLY									Record 37
1. Location of water facilities	1	2	3	1	2	1	2		11-13
2. Water production records	1	2	3	1	2	1	2		
3. Water quality records/monitoring	1	2	3	1	2	1	2		
4. Pressure regulating system	1	2	3	1	2	1	2		
5. Maintenance records/scheduling/ monitoring	1	2	3	1	2	1	2		
6. Construction records/scheduling/ monitoring	1	2	3	1	2	1	2		
7. Irrigation data	1	2	3	1	2	1	2		
8. Cost accounting	1	2	3	1	2	1	2		
Other Water Supply Files:									
9.	1	2	3	1	2	1	2		
10.	1	2	3	1	2	1	2		
BB. UTILITIES									
Water Operations:									
1. Inventory and location	1	2	3	1	2	1	2		
2. Service orders	1	2	3	1	2	1	2		
3. Field order dispatching	1	2	3	1	2	1	2		
4. Utility billing	1	2	3	1	2	1	2		
5. Utility accounting	1	2	3	1	2	1	2		
6. Customer inquiry	1	2	3	1	2	1	2		
7. Consumption data	1	2	3	1	2	1	2		
8. Load management system	1	2	3	1	2	1	2		63-64

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COMMUNITY DEVELOPMENT, PUBLIC WORKS, AND UTILITIES	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line? Yes	Is it operating on-line? No	Is it in a DBMS? Yes	Is it in a DBMS? No	If the application is part of a larger or integrated system, please name system	Record 38
Water Administration (Answer Only If Separate From City's General Applications):									
9. Vehicle maintenance records	1	2	3	1	2	1	2		11-13
10. Payroll preparation and accounting	1	2	3	1	2	1	2		
11. General accounting	1	2	3	1	2	1	2		
12. Cost accounting	1	2	3	1	2	1	2		
13. Employee records	1	2	3	1	2	1	2		
Electricity Operations:									
14. Inventory and location	1	2	3	1	2	1	2		
15. Service orders	1	2	3	1	2	1	2		
16. Field order dispatching	1	2	3	1	2	1	2		
17. Utility billing	1	2	3	1	2	1	2		
18. Utility accounting	1	2	3	1	2	1	2		
19. Customer inquiry	1	2	3	1	2	1	2		
20. Consumption data	1	2	3	1	2	1	2		
21. Load management system	1	2	3	1	2	1	2		47-49
Electricity Administration (Answer Only If Separate From City's General Applications):									Record 39
22. Vehicle maintenance records	1	2	3	1	2	1	2		11-13
23. Payroll preparation and accounting	1	2	3	1	2	1	2		
24. General accounting	1	2	3	1	2	1	2		
25. Cost accounting	1	2	3	1	2	1	2		
26. Employee records	1	2	3	1	2	1	2		
Gas Operations:									
27. Inventory and location	1	2	3	1	2	1	2		
28. Service orders	1	2	3	1	2	1	2		
29. Field order dispatching	1	2	3	1	2	1	2		
30. Utility billing	1	2	3	1	2	1	2		
31. Utility accounting	1	2	3	1	2	1	2		
32. Customer inquiry	1	2	3	1	2	1	2		
33. Consumption data	1	2	3	1	2	1	2		
34. Load management system	1	2	3	1	2	1	2		47-49

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COMMUNITY DEVELOPMENT, PUBLIC WORKS, AND UTILITIES	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record 40
Gas Administration (Answer Only If Separate From City's General Applications):									
35. Vehicle maintenance records	1	2	3	1	2	1	2		11-13
36. Payroll preparation and accounting	1	2	3	1	2	1	2		
37. General accounting	1	2	3	1	2	1	2		
38. Cost accounting	1	2	3	1	2	1	2		
39. Employee records	1	2	3	1	2	1	2		
Other Utility Files:									
40.	1	2	3	1	2	1	2		
41.	1	2	3	1	2	1	2		29-31

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HUMAN RESOURCES	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line?		Is it in a DBMS?		If the application is part of a larger or integrated system, please name system	
				Yes	No	Yes	No		Record 41
CC. PUBLIC HEALTH									
Clinical Services:									
1. Facilities identification and location	1	2	3	1	2	1	2		11-13
2. Facilities utilization	1	2	3	1	2	1	2		
3. Client intake/eligibility records	1	2	3	1	2	1	2		
4. Patient medical/treatment records	1	2	3	1	2	1	2		
5. Patient scheduling	1	2	3	1	2	1	2		
6. Patient billing and accounting	1	2	3	1	2	1	2		
7. Manpower scheduling	1	2	3	1	2	1	2		
8. Mental health exam/treatment	1	2	3	1	2	1	2		
9. Pharmacy records	1	2	3	1	2	1	2		
10. Laboratory/x-ray analysis records	1	2	3	1	2	1	2		
11. Immunization records	1	2	3	1	2	1	2		
12. Drug treatment records	1	2	3	1	2	1	2		
13. Communicable disease records	1	2	3	1	2	1	2		
14. Dental records	1	2	3	1	2	1	2		
15. Equipment/medical supply inventory	1	2	3	1	2	1	2		
16. Medicaid/Medicare reporting system	1	2	3	1	2	1	2		56-58
Environmental Health:									Record 42
17. Health certificates/permits	1	2	3	1	2	1	2		11-13
18. Health inspection records	1	2	3	1	2	1	2		
19. Insect and rodent inspection records	1	2	3	1	2	1	2		
20. Air quality monitoring and records	1	2	3	1	2	1	2		
21. Toxic waste transportation and disposal records	1	2	3	1	2	1	2		
22. Weed abatement records	1	2	3	1	2	1	2		
Public Hospitals:									
23. Facilities identification and location	1	2	3	1	2	1	2		
24. Facilities utilization	1	2	3	1	2	1	2		
25. Client intake/eligibility records	1	2	3	1	2	1	2		
26. Patient medical/treatment records	1	2	3	1	2	1	2		
27. Patient scheduling	1	2	3	1	2	1	2		
28. Patient billing and accounting	1	2	3	1	2	1	2		
29. Manpower scheduling	1	2	3	1	2	1	2		
30. Mental health exam/treatment	1	2	3	1	2	1	2		
31. Pharmacy records	1	2	3	1	2	1	2		
32. Laboratory/x-ray analysis records	1	2	3	1	2	1	2		
33. Immunization records	1	2	3	1	2	1	2		59-61

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HUMAN RESOURCES	For each application listed, please indicate its current status:			For each application that is now operational, please answer the following THREE questions:					
	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record 43
Public Hospitals (Continued):									
34.Drug treatment records	1	2	3	1	2	1	2		11-13
35.Communicable disease records	1	2	3	1	2	1	2		
36.Dental records	1	2	3	1	2	1	2		
37.Equipment /medical supply inventory	1	2	3	1	2	1	2		
38.Medicaid/Medicare reporting system	1	2	3	1	2	1	2		
Miscellaneous:									
39.Health education records	1	2	3	1	2	1	2		
40.School nursing records	1	2	3	1	2	1	2		
41.~~Ambulance data~~	1	2	3	1	2	1	2		
42.Health information and referral system	1	2	3	1	2	1	2		
Other Public Health Files:									
43.	1	2	3	1	2	1	2		
44.	1	2	3	1	2	1	2		41-43
DD.PUBLIC WELFARE									Record 44
1. General assistance records	1	2	3	1	2	1	2		11-13
2. Client intake/eligibility records	1	2	3	1	2	1	2		
3. Grant/benefit application/calculation	1	2	3	1	2	1	2		
4. Manpower allocation	1	2	3	1	2	1	2		
5. AFDC records	1	2	3	1	2	1	2		
6. Aid to blind records	1	2	3	1	2	1	2		
7. ~~Aid to disabled records~~	1	2	3	1	2	1	2		
8. Senior citizen assistance records	1	2	3	1	2	1	2		
9. Local program case records (e.g., Homemakers, Neighborhood Service Center, Meals on Wheels, other local agencies)	1	2	3	1	2	1	2		
10.Caseworker/social worker case records	1	2	3	1	2	1	2		
11.Case management system	1	2	3	1	2	1	2		
12.Public housing assistance data	1	2	3	1	2	1	2		
13.Records on distribution of clothing, eye glasses, etc.	1	2	3	1	2	1	2		
14.Food stamp records	1	2	3	1	2	1	2		
15.Social Service Information and Referral System	1	2	3	1	2	1	2		
16.Welfare information reporting system	1	2	3	1	2	1	2		
Other Public Welfare Files:									
17	1	2	3	1	2	1	2		
18.	1	2	3	1	2	1	2		[illegible]

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HUMAN RESOURCES	For each application listed, please indicate its current status: Now Operational	Planned within two years	Not Operational, Not Planned	For each application that is now operational, please answer the following THREE questions: Is it operating on-line? Yes	No	Is it in a DBMS? Yes	No	If the application is part of a larger or integrated system, please name system	Record 45
EE. PARKS AND RECREATION									
1. Parks and recreation facility inventory	1	2	3	1	2	1	2		11-13
2. Facilities utilization	1	2	3	1	2	1	2		
3. Facilities maintenance records/ scheduling/monitoring	1	2	3	1	2	1	2		
4. Program registration	1	2	3	1	2	1	2		
5. Tourism control/resources	1	2	3	1	2	1	2		
6. Manpower allocation	1	2	3	1	2	1	2		
7. Tree inventory	1	2	3	1	2	1	2		
8. Vehicle maintenance scheduling/records	1	2	3	1	2	1	2		
9. Cost accounting	1	2	3	1	2	1	2		
Other Parks and Recreation Files:									
10.	1	2	3	1	2	1	2		
11.	1	2	3	1	2	1	2		41-43
FF. VITAL STATISTICS									Record 46
1. Birth records	1	2	3	1	2	1	2		11-13
2. Death records	1	2	3	1	2	1	2		
3. Marriage records	1	2	3	1	2	1	2		
4. Divorce records	1	2	3	1	2	1	2		
5. Adoption records	1	2	3	1	2	1	2		
6. Cemetery records	1	2	3	1	2	1	2		
Other Vital Statistics Files:									
7.	1	2	3	1	2	1	2		
8.	1	2	3	1	2	1	2		
GG. LIBRARIES									
1. Catalog system	1	2	3	1	2	1	2		
2. Patron records	1	2	3	1	2	1	2		
3. Book reservations	1	2	3	1	2	1	2		
4. Book ordering/acquisition	1	2	3	1	2	1	2		
5. Circulation records/overdue notices	1	2	3	1	2	1	2		
6. Book inventory	1	2	3	1	2	1	2		
7. Periodical/serial inventory	1	2	3	1	2	1	2		
8. Reference services	1	2	3	1	2	1	2		
9. Audio visual-inventory/scheduling	1	2	3	1	2	1	2		
10. Cost accounting	1	2	3	1	2	1	2		
Other Library Files:									
11.	1	2	3	1	2	1	2		
12.	1	2	3	1	2	1	2		68-70

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	Now Operational	Planned within two years	Not Operational, Not Planned	Is it operating on-line?		Is it in a DBMS?		If the application is part of a larger or integrated system, please name system	Record 47
				Yes	No	Yes	No		
HH. VOTER REGISTRATION									
1. Voter registration records	1	2	3	1	2	1	2		11-13
2. Voter mailing list	1	2	3	1	2	1	2		
3. Suspension notices	1	2	3	1	2	1	2		
4. Vote tabulation	1	2	3	1	2	1	2		
5. Vote auditing	1	2	3	1	2	1	2		
6. Automatic precincting	1	2	3	1	2	1	2		
7. Automatic redistricting	1	2	3	1	2	1	2		
Other Voter Registration Files:									
8.	1	2	3	1	2	1	2		
9.	1	2	3	1	2	1	2		35-37

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Thank you for completing the questionnaire. If there are any comments you would like to make, please use the space provided below. Please check for any unanswered questions and return as soon as conveniently possible in the return envelope to:

National Study Of Urban Information Systems
Public Policy Research Organization
University of California
Irvine, California 92717

Also, please provide the names and titles of those persons who completed this questionnaire.

Name	Title	Phone
Name	Title	Phone
Name	Title	Phone

Respondent's Comments

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UNIVERSITY OF CALIFORNIA, IRVINE

ICMA
INTERNATIONAL CITY MANAGEMENT ASSOCIATION

NATIONAL STUDY OF
URBAN INFORMATION SYSTEMS

NATIONAL LEAGUE OF CITIES

LOCAL GOVERNMENT DATA PROCESSING MANAGEMENT AND PLANNING SURVEY 1985

Dear Data Processing Manager:

GMIS
GOVERNMENT MANAGEMENT INFORMATION SCIENCES

This questionnaire, along with the Computers and Applications Questionnaire, is intended to collect information about the computer installation you now manage. Data from both these questionnaires will be combined with data from other cities nationwide, to identify the current state of computing technology in local governments.

We would greatly appreciate you, the manager of this installation, completing this questionnaire, or verifying the information provided if it must be completed by others. Please answer the questions only with respect to the installation you manage. We will contact any other computer installations within your government.

PUBLIC TECHNOLOGY INC.

In appreciation of your efforts, we will send you the 1985 version of the Municipal Information Systems Directory, a compilation of survey data from all participating governments. The 1975 Directory, resulting from our previous national survey, proved an invaluable resource guide for municipalities interested in the state-of-computing across the nation.

This study is being done with the cooperation and endorsement of the International City Management Association, Government Management Information Sciences, the National League of Cities, Public Technology Incorporated, the California Arizona Nevada Innovation Group, the Virginia Innovation Group and the Florida Innovation Group. Findings from the study will be disseminated through the newsletters and publications of these associations and through articles in professional journals.

CAN
CALIFORNIA ARIZONA NEVADA INNOVATION GROUP

Thank you for your time and participation. If you have any problems or questions concerning the completion of this questionnaire, please feel free to call us collect at (714) 856-5449. We would appreciate it if you could return the questionnaire to us within the next two weeks. A return envelope is enclosed for your convenience.

FLORIDA INNOVATION GROUP

Sincerely,

Kenneth L. Kraemer

Professor Kenneth L. Kraemer

VIRGINIA INNOVATION GROUP

PUBLIC POLICY RESEARCH ORGANIZATION

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TOPICAL OUTLINE OF QUESTIONNAIRE

Data Processing Management and Planning

- **Structural Arrangements**
- **Problems with Data Processing**
- **Policy Boards, Steering Committees**
- **Involvement in DP Decisionmaking**
- **User Involvement in DP**
- **Organizational Change**
- **User EDP Staff**
- **Charging For Computer Operations**
- **EDP Budget**
- **EDP Staff**
- **Microcomputer Policy**
- **Problems With Microcomputers**
- **Information Centers**
- **Public Access to Government Databases**
- **Data Processing Manager**
- **The Future of Information Systems: The 1990's**

Note: There are a variety of names used to refer to the information systems function in organizations. These include: data processing, information systems, information management, information resource management, and so forth. We use DATA PROCESSING for simplicity and consistency. Consequently, we refer to you, the person in charge of this function, as the DP Manager although your actual title may differ.

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		Record 1
QUESTIONNAIRE	☐☐☐☐	1-4
INSTALLATION	☐☐	5-6
CITY/COUNTY	☐☐☐☐	7-10

DATA PROCESSING MANAGEMENT AND PLANNING

STRUCTURAL ARRANGEMENTS

1. Which of the following best describes the organizational arrangement of *this* installation? (CIRCLE ONE NUMBER.)

A. A subunit, division, or bureau of a department, e.g., Finance, Police, General Services, etc. .... (PLEASE SPECIFY DEPARTMENT) ____________	1	11
B. An independent data processing department under the chief executive	2	
C. A public regional installation (operated by another local government or shared among several)	3	
D. A facilities management installation	4	
E. Other (PLEASE SPECIFY) ____________	5	

2. In what year did *this* installation first begin providing service? (ENTER YEAR)

Year installation began .... 19 ☐☐ 12-13

3. How many of each of the following kinds of computer installations provide data processing services to your government's departments? We define a computer installation as a set of hardware (mainframe or minicomputer) and staff operating more or less independently. (ENTER NUMBER IN EACH ROW; ENTER "0" IF NONE.)

A. A subunit, division, or bureau of a department	☐☐	14-15
B. Independent data processing department under the chief executive	☐	16
C. Public regional installation	☐	17
D. Facilities management installation	☐	18
E. Service bureau	☐☐	19-20
F. State agency (exclude hookups to nationwide networks such as NCIC)	☐	21

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4. Listed below is our information about the computer installations which provide data processing services to the departments and agencies of this government. This information was supplied by the Clerk's Office. Please review the list for its accuracy and make any necessary changes or additions. Exclude only private service bureaus.

NAME OF INSTALLATION	PLEASE MAKE NECESSARY CHANGES OR ADDITIONS IN THIS COLUMN:

Name of Manager ____________
Title ____________
Department ____________
Address ____________

Name of Manager ____________
Title ____________
Department ____________
Address ____________

Name of Manager ____________
Title ____________
Department ____________
Address ____________

Name of Manager ____________
Title ____________
Department ____________
Address ____________

Name of Manager ____________
Title ____________
Department ____________
Address ____________

Name of Manager ____________
Title ____________
Department ____________
Address ____________

Name of Manager ____________
Title ____________
Department ____________
Address ____________

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5. Please list every municipality and county (exclude special districts) which *your* installation *provides EDP services to on a regular basis*, and the year you began providing service to each. Record 1

Municipalities and Counties serviced	Year began servicing	
A. ______	19 ☐☐	22-23
B. ______	19 ☐☐	24-25
C. ______	19 ☐☐	26-27
D. ______	19 ☐☐	28-29
E. ______	19 ☐☐	30-31
F. ______	19 ☐☐	32-33
G. ______	19 ☐☐	34-35
H. ______	19 ☐☐	36-37
I. ______	19 ☐☐	38-39
J. ______	19 ☐☐	40-41

6. Does your installation have responsibility for cable or CATV, or does it expect to have responsibility for it within the next five years? (CIRCLE ONE NUMBER.) 42

Does not have and will not have responsibility........ 1
Currently has responsibility........ 2
Expects to have responsibility within next five years........ 3

7. For the following areas of telecommunications, indicate whether your installation currently has responsibility, expects to have responsibility within the next five years, or does not and will not have responsibility for the area. (CIRCLE ONE NUMBER IN EACH ROW.)

Area of Telecommunications:	Does Not and Will Not Have	Now Has	Expects To Have	
A. Data communications, i.e., machine to machine	1	2	3	43
B. Voice communications, i.e., telephone, PBX	1	2	3	44
C. Radio communications, i.e., emergency service radios	1	2	3	45

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PROBLEMS WITH DATA PROCESSING IN LOCAL GOVERNMENTS

Record 1

8. Below are listed problems sometimes associated with data processing in local government. Indicate for each whether this has been a problem with services to this government in the last two years.
(CIRCLE ONE NUMBER IN EACH ROW.)

OPERATIONAL PROBLEMS	Not A Problem	At Times A Problem	Often A Problem	Very Often A Problem	
A. Unreliable performance of the computer hardware	1	2	3	4	46
B. Inadequate performance of application software	1	2	3	4	47
C. Unreliable performance of the operating system	1	2	3	4	48
D. Operation schedules delayed beyond deadlines	1	2	3	4	49
E. New applications not completed by promised delivery dates	1	2	3	4	50
F. Overall cost of EDP operations considered too high by top local government officials	1	2	3	4	51
G. High costs of training EDP staff	1	2	3	4	52
H. High costs of training EDP users to use applications	1	2	3	4	53
I. High costs of modifying application programs to meet frequent changes in state reporting requirements	1	2	3	4	54
J. EDP staff salaries not competitive with local business and industry	1	2	3	4	55
K. Cuts in EDP operations budget	1	2	3	4	56
L. Cuts in EDP design and development budget	1	2	3	4	57
M. Inaccuracy of data supplied to EDP unit	1	2	3	4	58
N. Development programmers frequently encountering 'minor' software emergencies with operational programs	1	2	3	4	59
O. Too few analysts	1	2	3	4	60
P. Too few application programmers	1	2	3	4	61
Q. Difficulty in recruiting good EDP personnel	1	2	3	4	62

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	Not A Problem	At Times A Problem	Often A Problem	Very Often A Problem	Record 1
R. Inadequate documentation of operating procedures for computer operations staff	1	2	3	4	63
S. Inadequate documentation of application programs for users	1	2	3	4	64
T. Inadequate documentation of programs to facilitate easy maintenance by programming staff	1	2	3	4	65
U. Large number of old programs that should be redeveloped	1	2	3	4	66
MANAGEMENT AND USER ACCEPTANCE PROBLEMS					
V. Lack of acceptance of EDP by top local government officials	1	2	3	4	67
W. Lack of acceptance of EDP by major department heads	1	2	3	4	68
X. Lack of acceptance of EDP by staff of user departments	1	2	3	4	69
Y. User departments not knowledgeable about EDP	1	2	3	4	70
Z. Programs do not meet user expectations	1	2	3	4	71
AA. Users have unrealistically high expectations of what computers can do	1	2	3	4	72
BB. Users generally underestimate the time necessary for programming	1	2	3	4	73
CC. Users place heavy demands on EDP staff for advice and training	1	2	3	4	74
DD. Users don't take EDP staff advice	1	2	3	4	75

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POLICY BOARDS, STEERING COMMITTEES

Record 2

9. Is there a user board or steering committee for your installation?

Yes (CIRCLE NUMBER, CONTINUE WITH Q.10) 1

No (CIRCLE NUMBER, SKIP TO Q.14) 2

10. In what year was this user board or steering committee established? (ENTER YEAR.)

Year board/steering committee began .... 1 9 _ _ 12-13

11. Which of the following are functions of this board or steering committee? (CIRCLE ONE NUMBER IN EACH ROW.)

FUNCTIONS OF BOARD OR STEERING COMMITTEE:	Is a Function	Not a Function	
A. To provide technical guidance to the data processing manager	1	2	14
B. To represent top officials on questions of computer procurement, new developments and user satisfaction with data processing	1	2	15
C. To act on requests for access to data	1	2	16
D. To develop guidelines for protecting confidentiality and public disclosure of information	1	2	17
E. To set priorities for new applications	1	2	18
F. To set priorities for day-to-day operations	1	2	19
G. To review/approve computer hardware and/or software purchases	1	2	20
H. To review the performance of the DP unit and/or the DP Director	1	2	21
I. To review/approve EDP plans	1	2	22

12. Which of the following individuals or groups are represented on this board or steering committee? (CIRCLE ONE NUMBER IN EACH ROW.)

MEMBERS OF BOARD OR STEERING COMMITTEE:	Is a Member	Not a Member	
A. Data Processing Department	1	2	23
B. Departments which are major users of data processing services	1	2	24
C. Departments which are minor users of data processing services	1	2	25
D. Departments not now using data processing services	1	2	26
E. Chief Executive's Office	1	2	27
F. Legislative body, council	1	2	28
G. Citizens	1	2	29
H. Other (s) (PLEASE SPECIFY) ____________	1	2	30

13. How influential do you consider this board or steering committee to be in your installation's data processing decisions? (CIRCLE ONE NUMBER.)

Not influential 1 31

Somewhat influential 2

Influential 3

Very influential 4

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INVOLVEMENT IN DP DECISIONMAKING

14. For each data processing decision listed below, please indicate all the individuals or groups involved in making the data processing decision. (CIRCLE THE APPROPRIATE NUMBER IN EACH COLUMN (INDIVIDUAL/GROUP), FOR EACH ROW (DECISION).) Record 2

Which individuals or groups are involved in:	Data Processing Manager		Department Head over Data Processing		User Department Heads		Chief Admin-istrative Officer		Local Legislative Body		User Board or Steering Committee		
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	
A. Deciding whether or not a new set of computer applications will be adopted.	1	2	1	2	1	2	1	2	1	2	1	2	32-37
B. Setting priorities for the development of new applications	1	2	1	2	1	2	1	2	1	2	1	2	38-43
C. Approving budget requests for *major* computer equipment purchases.	1	2	1	2	1	2	1	2	1	2	1	2	44-49
D. Approving requests for new computer equipment in user departments, for example, terminals, microcomputers, printers.	1	2	1	2	1	2	1	2	1	2	1	2	50-55
E. Evaluating the services provided by your installation.	1	2	1	2	1	2	1	2	1	2	1	2	56-61
F. Major reorganizations, such as changing the departmental status or location of EDP, or consolidating several independent EDP units.	1	2	1	2	1	2	1	2	1	2	1	2	62-67

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15. For each data processing decision listed below, please indicate which one of the individuals or groups is the *most influential* for each decision. (CIRCLE *ONE* NUMBER FOR EACH ROW.)

Which individual or group is most influential:	Data Processing Manager	Department Head over Data Processing	User Department Heads	Chief Administrative Officer	Local Legislative Body	User Board or Steering Committee	Record 2
A. Deciding whether or not a new set of computer applications will be adopted	1	2	3	4	5	6	68
B. Setting priorities for the development of new applications.	1	2	3	4	5	6	69
C. Approving budget requests for major computer equipment purchases.	1	2	3	4	5	6	70
D. Approving requests for new computer equipment in user departments, for example, terminals, microcomputers, printers.	1	2	3	4	5	6	71
E. Evaluating the services provided by your installation.	1	2	3	4	5	6	72
F. Major reorganizations, such as changing the departmental status or location of EDP, or consolidating several independent EDP units.	1	2	3	4	5	6	73

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USER INVOLVEMENT IN DP

Record 3

16. For each of the following kinds of activities, indicate how frequently *users* of your installation participate. (CIRCLE ONE NUMBER IN EACH ROW.)

DO USERS:	Never	Seldom	Often	Always	
A. Perform systematic analysis of benefits and costs anticipated from a proposed computer application	1	2	3	4	11
B. Work as members of a technical group in designing an application	1	2	3	4	12
C. Review designs for a new application	1	2	3	4	13
D. Do the programming necessary for an application	1	2	3	4	14
E. Provide test data for an application	1	2	3	4	15
F. Formally evaluate applications they use	1	2	3	4	16
G. Sign off, accepting an application	1	2	3	4	17
H. Sit on a user board/steering committee overseeing the computer unit	1	2	3	4	18
I. Participate in assigning priority to data processing projects	1	2	3	4	19
J. Provide informal feedback on problems with the data processing unit	1	2	3	4	20
K. Complete questionnaires or evaluation forms on their satisfaction with data processing service	1	2	3	4	21
L. Perform systematic analysis of benefits and costs derived from implemented computer applications	1	2	3	4	22
M. Initiate major changes in EDP applications, (such as changing the flow of information, the input or output)	1	2	3	4	23

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ORGANIZATIONAL CHANGE

17. Has this installation experienced any of the following changes within the last two years? Are any of the following changes planned for next year? (FOR EACH ROW, CIRCLE ONE NUMBER UNDER RECENT CHANGE, AND CIRCLE ONE NUMBER UNDER PLANNED CHANGE.) Record 3

	CHANGE WITHIN LAST 2 YEARS		PLANNED FOR NEXT YEAR		
	Yes	No	Yes	No	
A. A change in top EDP management	1	2	1	2	24-25
B. A change of mainframe vendors, switching from one vendor to another	1	2	1	2	26-27
C. A change in generation of machine	1	2	1	2	28-29
D. A change in the number of CPU's	1	2	1	2	30-31
E. A change in physical location	1	2	1	2	32-33
F. A change in departmental location or status	1	2	1	2	34-35
G. A change in relationships between computer installations, such as centralization of EDP	1	2	1	2	36-37
H. A change in development priorities for major new systems, such as emphasizing police systems rather than a previously planned system	1	2	1	2	38-39
I. A change in size of CPU, a significant upgrading	1	2	1	2	40-41
J. A major change in sophistication of the operating system	1	2	1	2	42-43
K. A major change in kind or level of programming language available, such as moving from procedural to non-procedural languages	1	2	1	2	44-45

18. Does this installation have a long range (2 years or more) EDP plan? (CIRCLE ONE NUMBER.)

Yes .... 1 — 46

No 2

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USER EDP STAFF

Record 3

19. Please list the number of EDP personnel (***excluding those on your own staff***) currently located within, and paid by, departments and agencies using your installation. (ENTER APPROXIMATE NUMBER IN EACH ROW)

Kinds of EDP Personnel	Number Employed Within Departments And Agencies Using This Installation	
A. Systems analysts	[ ][ ][ ]	47-49
B. Programmer analysts	[ ][ ][ ]	50-52
C. Application programmers	[ ][ ][ ]	53-55
D. Data entry personnel	[ ][ ][ ]	56-58

EDP CHARGING FOR OPERATIONS

20. How are data processing operations, namely computer time and memory, generally financed by your installation? (CIRCLE ONE NUMBER.)

Line item in budget with no charge to any users for service. (CIRCLE NUMBER, SKIP TO Q.24) 1
Charges to non-general fund departments, free to general fund departments 2
All user departments are charged 3
Other (SPECIFY) ________________ 4

59

21. For each agency and department charged, is the charge a flat fee or a variable fee based on amout of computer use? (CIRCLE ONE NUMBER.)

Flat fee 1
Variable fee based on use 2

60

22. Approximately what percentage of the actual operating costs does this fee generally cover? (ENTER PERCENT.)

Percent fee covers = [ ][ ][ ] % 61-63

23. Which of the following are used to determine charges for computer operations in your installation? (CIRCLE ONE NUMBER IN EACH ROW.)

	Yes	No	
A. Connect time	1	2	64
B. CPU time	1	2	65
C. Transaction volume	1	2	66
D. Tape use	1	2	67
E. Paper use	1	2	68
F. Disk storage	1	2	69
G. Overhead	1	2	70
H. Other (PLEASE SPECIFY) ________________	1	2	71

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Record 4

24. Regardless of whether user departments are or are not charged, are data processing expenditures for user departments compiled for planning and budgeting purposes? (CIRCLE ONE NUMBER.)

Yes	1	11
No	2	

25. What is the primary method used by your installation for acquiring most of your computers and peripheral equipment? (CIRCLE ONE NUMBER.)

Purchase	1	
Rental	2	12
Lease	3	
Other (PLEASE SPECIFY)________	4	

26. Do you obtain most of your hardware directly from a vendor or through a third party source? (CIRCLE ONE NUMBER.)

Vendor	1	
Third party	2	13
Other (PLEASE SPECIFY)________	3	

27. Are systems development costs paid from a general pool or from each department's budget? (CIRCLE ONE NUMBER.)

General pool	1	14
Each department's budget	2	

EDP BUDGET

28. For this fiscal year, what is your installation's total budget? (ENTER DOLLAR AMOUNT)

Total Budget = $ ☐☐ , ☐☐☐ , 0 0 0 — 15-19

29. Approximately what percent of the total budget is devoted to personnel salaries and fringe benefits? (ENTER PERCENT)

Percent of budget devoted to personnel = ☐☐☐ % — 20-22

30. Approximately what percent of the total budget is devoted to hardware purchases? (ENTER PERCENT)

Percent of budget devoted to hardware = ☐☐☐ % — 23-25

31. What has been the average annual change in DP expenditures in your installation over the past five years? (CIRCLE ONE NUMBER.)

Decreased more than 20%	1	
Decreased 10-20%	2	
Decreased less than 10%	3	
Stayed about the same	4	26
Increased less than 10%	5	
Increased 10-20%	6	
Increased more than 20%	7	

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Record 4

EDP STAFF

32. What is the total number of full-time equivalent staff in your installation? (ENTER NUMBER.)

Total full-time equivalent staff = [| |] 27-29

33. Please provide the current number of staff using the following classifications. (ROUND UP TO NEAREST FULL NUMBER FOR EACH POSITION.)

A. Total Operations Staff: includes computer operators, systems programmers, data entry staff, tape librarian, database administrators [| |] 30-32

B. Total Development Staff: includes application programmers and systems analysts [| |] 33-35

C. Total User Services Staff: includes office automation, information center, and user consultant staff [| |] 36-38

D. Total Administrative Staff: includes management and administrative support staff [| |] 39-41

MICROCOMPUTER POLICY

34. Does your installation have any written policy regarding microcomputer procurement and/or use? (CIRCLE ONE NUMBER.)

Yes.. 1
No.. 2 42

35. Has your installation made a policy to standardize the procurement of microcomputers to a single vendor, or to a selected list of vendors? (CIRCLE ONE NUMBER.)

Yes.. 1
No.. 2 43

36. Has your installation made a policy to standardize the procurement of microcomputer software to a selected list of "approved" software? (CIRCLE ONE NUMBER.)

Yes.. 1
No.. 2 44

37. PLEASE FILL IN THE FOLLOWING INFORMATION IF YOUR INSTALLATION, OR THE DEPARTMENTS AND AGENCIES SERVED BY YOUR INSTALLATION, HAVE ANY MICROCOMPUTERS, OR PLAN TO PROCURE MICROCOMPUTERS IN THE NEXT YEAR. IF NO MICROCOMPUTERS, PLEASE SKIP TO QUESTION #41. (ENTER NUMBER.)

		Microcomputers Now In Use	Microcomputers Planned In Next Year	
A.	Total number of microcomputers	[| | |]	[| | |]	45-52
B.	Number of microcomputers connected to minicomputers or mainframes in your installation	[| | |]	[| | |]	53-60

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38. What are the primary vendors of the microcomputers? Please indicate the percent for each vendor. (ENTER PERCENT.)

A. Wang		61-63
B. IBM		64-66
C. Apple		67-69
D. Other (SPECIFY)________		70-72

Record 4

39. Please allocate the total number of microcomputers now in use, and /or the total number planned for procurement in the next year, to the categories listed:

Record 5

	Microcomputers Now in Use	Microcomputers Planned in Next Year	
A. Your installation			11-14
B Police Protection			15-18
C. Fire Protection			19-22
D Courts			23-26
E Accounting/Finance/Comptroller			27-30
F Treasury/Collection			31-34
G. Assessment			35-38
H. Budgeting and management			39-42
I. Purchasing/Inventory			43-46
J. Personnel			47-50
K. Clerk/Recorder			51-54
L. Central Garage/Motor Pool			55-58
M. Planning and Zoning			59-62
N Housing and Urban Renewal			63-66
O Licensing and Code Enforcement			67-70
P. Public Works/Engineering			71-74
Q. Transportation			Record 6 11-14
R. Public Utilities			15-18
S. Public Health/Welfare			19-22
T. Library			23-26
U. City Attorney			27-30
V. Parks and Recreation			31-34
W. Public Facilities (museums, convention centers, etc.)			35-38
X. Other			39-42

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PROBLEMS WITH MICROCOMPUTERS

Record 6

40. Listed below are problems sometimes associated with the use of microcomputers in local governments. For each, indicate how frequently they have been a problem for your installation. (CIRCLE ONE NUMBER IN EACH ROW.)

	Not A Problem	At Times A Problem	Often A Problem	Very Often A Problem	
A. Users spending a large amount of time programming their own applications	1	2	3	4	43
B. Users spending time keying in data on microcomputers that is already on the mainframe and could be transferred to their microcomputers more efficiently	1	2	3	4	44
C. DP staff being called upon to deal with word processor and microcomputer compatibility problems within departments.	1	2	3	4	45
D. DP staff being called upon to deal with word processor and microcomputer compatibility problems between departments.	1	2	3	4	46
E. DP staff being called upon to deal with compatibility problems between department word processors /microcomputers and the central mainframes.	1	2	3	4	47
F. Contention between DP staff and users about control over microcomputers	1	2	3	4	48
G. Clarity of policy about control over microcomputers.	1	2	3	4	49
H. Users placing too much demand on EDP staff for advice and training on microcomputers.	1	2	3	4	50
I. Users picking inappropriate languages for programming on their microcomputers	1	2	3	4	51
J. Users not following established software development practices when they write programs on their microcomputers	1	2	3	4	52
K. Users not adequately documenting software that they have developed on their microcomputers	1	2	3	4	53
L. Users developing idiosyncratic programs which are hard for others to figure out and use.	1	2	3	4	54
M. Users developing DP 'fiefdoms' from a microcomputer base	1	2	3	4	55

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INFORMATION CENTERS

Record 6

41. Has your DP installation established dedicated, physically separate "Information Center(s)"? *By an "Information Center" we mean a special unit with staff, computing and software resources, organized and devoted to support end users.* (CIRCLE ONE NUMBER.)

Yes (CONTINUE) 1
No (SKIP TO Q.50) .... 2 — 56

42. Which of the following hardware arrangements best describes your Information Center? (CIRCLE ONE NUMBER)

Mainframe only 1
Minicomputer only 2
Microcomputers only 3
Mainframe and microcomputer .... 4 — 57
Minicomputer and microcomputer 5
Mainframe, minicomputer and microcomputer 6
Outside timesharing services (e.g., IBM's Information Network; Sperry's Mapper Executive Information Service Center) 7
Other (PLEASE SPECIFY) ____________ 8

43. Which organizational arrangement best describes your Information Center? (CIRCLE ONE NUMBER)

Centralized location .... 1 — 58
Dispersed, with staff posted throughout user departments 2

44. How many full-time and part-time staff members support your Information Center? (ENTER TOTAL NUMBER IN EACH ROW.)

Total number of part-time staff = [| |] — 59-61
Total number of full-time staff = [| |] — 62-64

45. The following is a list of functions that Information Centers typically perform. Please indicate for each whether this is not a function, is a minor function, or is a major function of your Information Center. (CIRCLE ONE NUMBER IN EACH ROW.)

	Not a Function	Minor Function	Major Function	
A. Education/training of users	1	2	3	65
B. On-going consultation for users	1	2	3	66
C. Technical support for users	1	2	3	67
D. Testing new software	1	2	3	68
E. Providing access to internal databases for users	1	2	3	69
F. Providing access to external databases for users	1	2	3	70
G. Planning for Information Center expansion	1	2	3	71
H. Marketing the Information Center within the organization	1	2	3	72
I. Other (PLEASE SPECIFY) ____________	1	2	3	73

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46. For each software tool listed, please indicate whether your Information Center supports it on a mainframe, a microcomputer, on both, or on neither. (CIRCLE ONE NUMBER IN EACH ROW.) Record 7

	Mainframe/ Minicomputer	Micro-computer	Both	Neither	
A. Database management	1	2	3	4	11
B. Modeling system, e.g., for planning, budget	1	2	3	4	12
C. Spreadsheet	1	2	3	4	13
D. Text/word processing	1	2	3	4	14
E. Statistical analysis	1	2	3	4	15
F. Graphics generation	1	2	3	4	16
G. Electronic mail	1	2	3	4	17
H. Calendaring	1	2	3	4	18
I. Interactive report/query generation	1	2	3	4	19
J. Interactive structured programming language	1	2	3	4	20
K. Other (PLEASE SPECIFY) ________	1	2	3	4	21

47. Please indicate the total number of software packages available for users of your Information Center (ENTER TOTAL NUMBER FOR EACH APPLICABLE HARDWARE.)

A. Total mainframe software packages = [| |] 22-24

B. Total minicomputer software packages = [| |] 25-27

C. Total microcomputer software packages = [| |] 28-30

48. How many trained, regular users does your Information Center support? (ENTER NUMBER.)

Number of trained, regular users = [| |] 31-33

IF YOUR INFORMATION CENTER CONTAINS MICROCOMPUTERS, PLEASE CONTINUE.
IF NOT, PLEASE SKIP TO QUESTION #50.

49. If your Information Center includes microcomputers, which of the following functions does it perform? (CIRCLE ONE NUMBER IN EACH ROW.)

	Yes	No	
A. Testing new microcomputer hardware	1	2	34
B. Setting standards for user purchase of micro-related equipment	1	2	35
C. Making recommendations on user requests for micro-related equipment	1	2	36
D. Evaluating user requests for micro-related equipment	1	2	37
E. Other (PLEASE SPECIFY) ________________	1	2	38

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PUBLIC ACCESS TO GOVERNMENT DATABASES

Record 7

50. Within the past two years, have members of any of the following groups complained, on the basis of privacy, about the collection or release of any computerized personal information by your government? (CIRCLE ONE NUMBER IN EACH ROW.)

	Yes	No	
A. Individuals named in the records	1	2	39
B. Professional, civic, or community groups	1	2	40
C. Local Government employees	1	2	41
D. Federal or state government agencies	1	2	42

51. Does your government now have any ordinances controlling the collection and release of personal information on individuals?

Yes........ 1

No 2 43

52. Do you permit any public access to government operations databases such as property or financial databases?

Yes (Continue)........ 1 44

No (Skip to Q.56)........ 2

53. How is such access provided to the public? (CIRCLE ONE NUMBER IN EACH ROW.)

	Yes	No	
A. Through a tape or other machine readable copy of the database	1	2	45
B. Through a terminal in a city office	1	2	46
C. Through a terminal in their own premises	1	2	47
D. Through printed form	1	2	48
E. Other (PLEASE SPECIFY) ________________	1	2	49

54. What databases have been commonly requested? (CIRCLE ONE NUMBER IN EACH ROW.)

	Yes	No	
A. Voter registration files	1	2	50
B. Property files	1	2	51
C. Licensing files	1	2	52
D. City planning files	1	2	53
E. Other (PLEASE SPECIFY) ________________	1	2	54

55. Please rank order the four groups listed below from the most frequent users (rank number 1) to the least frequent users (rank number 4) of government databases. (ENTER RANK NUMBER IN EACH BOX.)

A. Individual citizens ☐ 55

B. Local media ☐ 56

C. Professional, civic or community groups ☐ 57

D. Private business or industry ☐ 58

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19

Record 7

DATA PROCESSING MANAGER

56. Which description below *best* describes your current role as a data processing manager? (CIRCLE *ONE* NUMBER.)

Introduce technological innovation and educate top managers and users on the future of data processing	1	
Carry out directives of top management and coordinate data processing activity	2	
Work with top management to determine data processing directions and translate user requirements into systems	3	59
The role of the data processing manager is in transition or at present is unclear	4	

57. Please rank the relative importance of the following tasks to this installation this year. Number '1' is most important and number '7' is least important. (ENTER RANK NUMBER IN EACH BOX.)

A.	Integrating data processing and telecommunications	☐	60
B.	Installing office automation (e.g., word processing, electronic mail, etc.)	☐	61
C.	Revamping old systems	☐	62
D.	Expanding data processing within departments/areas that currently use computing	☐	63
E.	Expanding data processing to departments/areas that do not now use computing	☐	64
F.	Keeping existing administrative systems running and current	☐	65
G.	Installing local area networks	☐	66

58. What is the *primary* purpose of your DP Planning activities? (CIRCLE ONE NUMBER ONLY.)

Minimize expenditures on hardware and software	1	
Meet growing user demand	2	67
Stay at leading edge of the technology	3	
Establish or clarify the role of DP in the organization	4	

59. Which statement *best describes* your method for managing technological change? (CIRCLE ONE NUMBER ONLY.)

Mainstream, stay with proven technologies	1	
Maintain base of proven technologies, and experiment with selected new technologies	2	68
Adopt a wide range of advanced technologies as they emerge	3	
Develop entirely new technologies in-house	4	

60. How many years have you been in your present position? (ENTER NUMBER)

Total years in position = ☐☐ 69-70

61. How many years have you worked for this government? (ENTER NUMBER)

Total years in government = ☐☐ 71-72

62. What is the highest educational level you have completed? (CIRCLE ONE NUMBER ONLY)

High school degree	1	
Some college	2	
College degree	3	73
Some graduate or professional school	4	
Graduate or professional degree beyond bachelors	5	

63. Are you currently a member of a regional, state or national organization or association for your profession?

No	1	
Yes, but never attend meetings	2	74
Yes, and attend meetings	3	

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THE FUTURE OF INFORMATION SYSTEMS: THE 1990's

64. The following are a series of *predictions* about local government computing *five years from now*. For each prediction, please indicate the extent to which you agree or disagree with the prediction. (CIRCLE ONE NUMBER IN EACH ROW.)

Five years from now:	Strongly Disagree	Disagree	Agree	Strongly Agree	Record 8
A. Federal programs and funding will have a negligible impact on local government computing.	1	2	3	4	11
B. Local governments will be increasingly pressured to participate in State-wide information systems.	1	2	3	4	12
C. The DP Manager's organizational role will evolve into that of the Chief Executive Officer.	1	2	3	4	13
D. An increasing number of DP Managers will be promoted to the position of Chief Executive Officer	1	2	3	4	14
E. Maintaining core administrative computing (e.g., finance, revenue collection, personnel/payroll system) will be the top priority	1	2	3	4	15
F. Meeting new end user demands will be the top DP priority.	1	2	3	4	16
G. Computing use will be expanded beyond the functional areas now involved with computing.	1	2	3	4	17
H. Systems integration will be the primary goal of systems expansion.	1	2	3	4	18
I. Systems will be increasingly adopted or developed to meet individual end users' needs.	1	2	3	4	19
J. End user computing growth will be limited to functional areas now using computing.	1	2	3	4	20
K. End user computing growth will include personnel in all the organization's functional areas.	1	2	3	4	21
L. Information centers, "computer stores", and office support groups will become major means for defining end user needs	1	2	3	4	22
M. Information centers, "computer stores", and office support groups will be managed by DP.	1	2	3	4	23
N. End user understanding of computing and its uses will increase substantially.	1	2	3	4	24
O. While computer literacy will spread through the organization, technical expertise will reside within DP.	1	2	3	4	25
P. Dedicating mainframe and minicomputers to specific applications will become common practice.	1	2	3	4	26
Q. Obtaining turnkey systems will become a common solution to specific user needs.	1	2	3	4	27
R. The costs of modifying turnkey systems to fit organizational needs will greatly reduce their use.	1	2	3	4	28
S. The need for systems integration will require that many turnkey applications and dedicated systems be returned to central mainframes.	1	2	3	4	29
T. End user computing will generate a greater need for large central mainframes.	1	2	3	4	30
U. Most work will be performed on powerful workstations rather than mainframes.	1	2	3	4	31
V. Organizations will obtain their equipment from one or from very few vendors.	1	2	3	4	32

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Five years from now:	Strongly Disagree	Disagree	Agree	Strongly Agree	Record 8
W. As new equipment is adopted, older equipment will be increasingly handed-down within the organization, thereby expanding access to computing	1	2	3	4	33
X. Vendor maintenance and support will outweigh hardware performance as a purchase criterion.	1	2	3	4	34
Y. User-friendly operating systems will be favored over those which are technically superior.	1	2	3	4	35
Z. Ensuring system compatibility will be a major responsibility of DP.	1	2	3	4	36

65. Please rank the following tasks according to their likely importance to this installation in five years. Number '1' will be most important and number '7' will be least important. (ENTER RANK NUMBER IN EACH BOX.)

A. Microcomputer acquisitions	☐	37
B. Office automation projects	☐	38
C. Telecommunications enhancements	☐	39
D Central facility operations	☐	40
E. Mainframe/minicomputer/microcomputer linkages	☐	41
F. Local Area Network developments	☐	42
G Turnkey application purchases	☐	43

66. Rank the following application areas in order of their likely growth in your organization ***over the next five years***, with number '1' likely to experience the greatest growth and number '8' likely to experience the least growth. (ENTER RANK NUMBER IN EACH BOX.)

A. Public Safety	☐	44
B. Finance	☐	45
C. Administration	☐	46
D. Data Processing	☐	47
E. Community Development	☐	48
F. Public Works	☐	49
G. Utilities	☐	50
H. Human Resources	☐	51

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Thank you for completing the questionnaire. If there are any comments you would like to make, please use the space provided below. Please check for any unanswered questions, place in the return envelope, and mail as soon as conveniently possible to:

National Study Of Urban Information Systems
Public Policy Research Organization
University of California
Irvine, California 92717

Also, please provide the names and titles of those persons who completed this questionnaire.

Name	Title	Phone
Name	Title	Phone
Name	Title	Phone

Respondent's Comments

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PUBLIC POLICY RESEARCH ORGANIZATION
UNIVERSITY OF CALIFORNIA, IRVINE

NATIONAL STUDY OF
URBAN INFORMATION SYSTEMS

LOCAL GOVERNMENT MANAGERS SURVEY 1986

Dear Respondent:

This questionnaire is intended to gather information about your local government. This survey is part of a continuing nationwide study on local government computing undertaken by the Public Policy Research Organization of the University of California, Irvine. It extends our national survey of 1985, which revealed the importance of understanding the environmental context in which computing occurs.

This questionnaire is primarily concerned with the organizational context of your government and will aid us in better understanding local government computing. We are specifically seeking the views of local government managers, so we would greatly appreciate your taking the time to complete this survey personally. It does not require special knowledge of data processing. In fact, this questionnaire should be completed even if your government does not currently use computers.

Your responses to this questionnaire will be kept confidential and will be summarized without reference to individuals. In appreciation of your continued support, we have enclosed a summary of city management and information systems management views on the future of computing in local governments. We hope you find these predictions useful for your own planning purposes.

This study is being done with the cooperation and endorsement of the Government Management Information Sciences, the National League of Cities, Public Technology Incorporated, the California Arizona Nevada Innovation Group, the Virginia Innovation Group, and the Florida Innovation Group. Findings for the study will be disseminated through the newsletters and publications of these associations and through articles in professional journals.

Thank you for your time and participation. If you have any problems or questions concerning the completion of this questionnaire, please feel free to call us collect at (714) 856-5449. Please return the questionnaire as soon as possible so we can quickly disseminate the results. A return envelope is enclosed for your convenience.

Sincerely,

Professor Kenneth L. Kraemer

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Record 1

THE MUNICIPAL CONTEXT OF DATA PROCESSING

GOVERNMENTAL CONTEXT:

1. Please characterize the officers within your city government according to the following responsibilities, powers, and term of office.
(FOR EACH ROW, CIRCLE ONE NUMBER IN EACH COLUMN)

	Mayor		City Manager or C.A.O.		
	No	Yes	No	Yes	
a. Responsible for appointing department heads	1	2	1	2	12-13
b. Responsible for preparing the city budget	1	2	1	2	14-15
c. Responsible for reorganization of city departments	1	2	1	2	16-17
d. Exclusive administrative authority over operating departments	1	2	1	2	18-19
e. Veto power over the local legislature	1	2	1	2	20-21
f. Length of elected/appointed term (ENTER NUMBER OF YEARS. IF INDETERMINATE, ENTER "00")	☐☐		☐☐		22-25
g. Maximum number of terms that can be served (ENTER NUMBER OF TERMS. IF INDETERMINATE, ENTER "00")	☐☐		☐☐		26-29

2. How many department and agency heads in your government are chosen by general elections rather than by appointment? (ENTER NUMBER)

Number of elected administrative officials = ☐☐ 30-31

WARNING: THIS NEXT QUESTION IS THE HARDEST ONE IN THIS SURVEY!!

3. The following question may require some additional inquiry such as contacting your city's personnel director. We ask that you try to complete it because the data is very important to our research.
First, think of all the **managers above first-level supervisor** employed in your city. Then complete the following distribution:

a. The total number of **managers in the Chief Administrator's/City Manager's office** (include the CA/CM, Deputies and Assistants) .... ☐☐☐☐ 32-35

b. The total number of **Department Heads** in this city .... ☐☐☐☐ 36-39

c. The total number of **Division/Bureau Heads** (if any) in this city .... ☐☐☐☐ 40-43

d. The total number of all **Middle-Managers (i.e., above first-level supervisors but below Division/Bureau Heads)** in this city .... ☐☐☐☐ 44-47

4. Overall, how has the use of computing changed the number of middle-managers in your city?

Greatly Decreased	Slightly Decreased	No Apparent Change	Slightly Increased	Greatly Increased	
1	2	3	4	5	48

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5. Excluding data processing, list in **rank order** the **six most influential departments** in this city, with number one considered the most influential. By most influential, we mean most often successful in getting their requests granted.

1. ______	4. ______	49-52
2. ______	5. ______	53-56
3. ______	6. ______	57-60

POLICY AND MANAGEMENT CONTEXT:

6. In the last few years how have planning, zoning, and other development policies of your local government been used to influence industrial and commercial growth? (CIRCLE ONE NUMBER)

Policies have been adopted to **limit** industrial and commercial growth................ 1
There is **no clear policy** regarding industrial and commercial growth .... 2 — 61
Policies have been adopted to **actively promote** industrial and commercial growth ...3

7. In the last few years how have planning, zoning, and other development policies of your local government been used to influence population change? (CIRCLE ONE NUMBER)

Tried to stop population decline...................... 1
No clear policy regarding population change........... 2 — 62
Tried to limit the rate of growth....................... 3
Tried to encourage population growth................. 4

8. Do departments and agencies within your local government establish written objectives for the programs and services they provide? (CIRCLE ONE NUMBER)

No 1
Yes, for some programs........ 2 — 63
Yes, for most programs......... 3

9. Do city departments have measures of performance in meeting the objectives of city programs? (CIRCLE ONE NUMBER)

No............................... 1
Yes, for a few programs.............. 2
Yes, for about half of the programs..... 3 — 64
Yes, for most of the programs......... 4
Yes, for all of the programs 5

10. Have city departments and agencies implemented cost accounting procedures to track or estimate the cost of major programs or activities? (CIRCLE ONE NUMBER)

No............................... 1
Yes, in a few cases.................. 2
Yes, in many cases................. 3 — 65
Yes, general procedure............... 4

11. Has a team management strategy (management decision making by a small group) been tried or implemented by top management in this city? (CIRCLE ONE NUMBER)

No 1
Yes, tried but not maintained......... 2 — 66
Yes, tried and implemented.......... 3

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3

FISCAL CONTEXT:

12. In the last five years, has your state or local electorate passed any ballot initiative to reduce, restrict, or otherwise limit taxes (i.e., property tax reduction)? (CIRCLE ONE NUMBER)

Yes 1
No (skip to Question 14.) ...... 2 — 67

13. If yes, how would you summarize its impact on your municipal revenues? (CIRCLE ONE NUMBER)

Large decrease in revenue 1
Slight decrease in revenue 2
No change in revenue .... 3 — 68
Slight increase in revenue 4
Large increase in revenue...... 5

14. In the last five years, how has your city's share of revenue from the federal government changed? (CIRCLE ONE NUMBER)

Large decrease in revenue 1
Slight decrease in revenue 2
No change in revenue .... 3 — 69
Slight increase in revenue 4
Large increase in revenue...... 5

15. In the last five years, how has your city's share of revenue from the state government changed? (CIRCLE ONE NUMBER)

Large decrease in revenue 1
Slight decrease in revenue 2
No change in revenue .... 3 — 70
Slight increase in revenue 4
Large increase in revenue...... 5

Record 2

16. In the past five years, in what areas have **new user fees** (including increases based on full-cost recovery) been initiated? (CIRCLE ONE NUMBER IN EACH ROW)

	Yes	No	Not a Function	
a. No new user fees (SKIP TO QUESTION 17.)	1	2	3	12
b. Police/Fire	1	2	3	13
c. Courts	1	2	3	14
d. Emergency Medical Services	1	2	3	15
e. Recreation/Parks	1	2	3	16
f. Libraries	1	2	3	17
g. Sewers/Drainage	1	2	3	18
h. Solid Waste/Sanitation	1	2	3	19
i. Streets/Transportation	1	2	3	20
j. Licensing/Code Enforcement	1	2	3	21
k. Planning/Zoning	1	2	3	22
l. Schools/Education	1	2	3	23
m. Other (Specify) ______	1	2	3	24

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17. The following is a list of options which various cities have used to mitigate revenue reductions from federal, state, or local sources. Please indicate the **overall importance of each option** to your government, over the past five years, in mitigating revenue reductions. (CIRCLE ONLY ONE RESPONSE FOR EACH ITEM)

		This Option Used By This City and Considered:					
	Not Used	Not Important	Slightly Important	Important	Very Important	Extremely Important	Record 2
I. EXTERNAL ENVIRONMENT OPTIONS:							
a. Privatize selected service programs	0	1	2	3	4	5	25
b. Contract-out selected service programs	0	1	2	3	4	5	26
c. Revitalize local economic base	0	1	2	3	4	5	27
d. Annex surrounding jurisdictions	0	1	2	3	4	5	28
e. Provide incentives to retain local firms	0	1	2	3	4	5	29
f. Provide incentives to attract additional firms	0	1	2	3	4	5	30
II. INTERNAL ORGANIZATION OPTIONS:							
a. Eliminate selected service programs	0	1	2	3	4	5	31
b. Reduce scope of all service programs	0	1	2	3	4	5	32
c. Reduce scope of selected service programs	0	1	2	3	4	5	33
d. Increase efficiency of service delivery	0	1	2	3	4	5	34
e. Restrain increases in employee salaries	0	1	2	3	4	5	35
f. Restrain increases in employee fringe benefits	0	1	2	3	4	5	36
g. Reduce the number of current employees	0	1	2	3	4	5	37
h. Reduce the number of new employees hired	0	1	2	3	4	5	38
i. Increase productivity of existing employees	0	1	2	3	4	5	39
j. Improve internal accounting/financial analysis	0	1	2	3	4	5	40
k. Reduce internal operating expenditures	0	1	2	3	4	5	41
l. Initiate energy conservation measures	0	1	2	3	4	5	42
m. Increase monitoring of revenue owed to city	0	1	2	3	4	5	43
n. Accelerate collection of revenue owed to city	0	1	2	3	4	5	44
III. FISCAL OPTIONS:							
a. Increase existing user fee rates	0	1	2	3	4	5	45
b. Establish new user fees for selected services	0	1	2	3	4	5	46
c. Increase license/permit fees	0	1	2	3	4	5	47
d. Reduce subsidy of employee retirement programs	0	1	2	3	4	5	48
e. Reduce subsidy of local utility operations	0	1	2	3	4	5	49
f. Reduce capital project expenditures	0	1	2	3	4	5	50
g. Increase bond financing use for capital projects	0	1	2	3	4	5	51
h. Increase property tax rates	0	1	2	3	4	5	52
i. Increase general sales tax rates	0	1	2	3	4	5	53
j. Increase selected sales tax rates	0	1	2	3	4	5	54
k. Increase local income tax rates	0	1	2	3	4	5	55
l. Restructure assessment rate and/or process	0	1	2	3	4	5	56
m. Increase return on investment portfolio	0	1	2	3	4	5	57
n. Increase interest return on cash reserves	0	1	2	3	4	5	58
o. Increase short-term municipal debt	0	1	2	3	4	5	59
p. Increase long-term municipal debt	0	1	2	3	4	5	60

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COMPUTING CONTEXT:

Record 3

18. The following statements summarize three accepted managerial views on the role of computing in government. Please rank order them 1, 2, and 3, with number 1 being the most accurate summary of your city management's perspective on computing and number 3 being the least accurate summary.

Computing is a specialized support service involving technical skills and technologies undergoing continual advances. Thus, this city's computing activity should be primarily concerned with keeping current with the state-of-the-art, on the grounds that continued advances in the technology provide improved capabilities for less cost and thereby better serve the city's needs .... Rank = ______ 12

Computing is a general purpose tool for city departments similar to other tools like vehicles and communications. Thus, this city's computing activity should be primarily concerned with increasing: departmental access to computing, user competence in computing, and applications which really serve operating department functions, on the grounds that departmental users can best apply computing to serve the city's needs .... Rank = ______ 13

Computing is a method for generating information to improve internal management and decisionmaking. Thus, this city's computing activity should be primarily concerned with insuring that management-level information is generated -- as special applications and/or as part of the applications developed for the operating departments -- on the grounds that increasing the available information for decisionmaking best serves the city's needs ...... Rank = ______ 14

19. Assume that funds for computer automation in your city are changed upward or downward by ten percent. Allocate these changes as you think the city's top management would allocate them across the following three categories for each column:

	Allocate a 10% Increase	Allocate a 10% Decrease	
a. Computer hardware and technical staff in the DP unit	a. ____ %	a. ____ %	15-18
b. Applications/services for operating departments	b. ____ %	b. ____ %	19-22
c. Applications/services for top management and staff departments	c. ____ %	c. ____ %	23-26

20. Overall, how important have computerized information systems been to your city's operations over the past five years? (CIRCLE ONE NUMBER)

Not Important	Slightly Important	Important	Very Important	Extremely Important	
1	2	3	4	5	27

21. More specifically, please rate how computerized information systems have affected **each** of the following aspects of your city's operations over the past five years. (CIRCLE ONE NUMBER)

How has computing affected:	Greatly Increased	Slightly Increased	No Apparent Effect	Slightly Decreased	Greatly Decreased	
a. Efficiency of service delivery?	1	2	3	4	5	28
b. Cost of service delivery?	1	2	3	4	5	29
c. Staff productivity?	1	2	3	4	5	30
d. Management effectiveness?	1	2	3	4	5	31
e. Operating expenditures?	1	2	3	4	5	32
f. Revenue collection?	1	2	3	4	5	33

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22. Please circle the one number in each row which best describes your agreement or disagreement with each of the following statements:
(CIRCLE ONE NUMBER IN EACH ROW)

	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Don't Know	Record 3
a. This city's top management takes a personal interest in DP.	1	2	3	4	5	34
b. This city's top management is very satisfied with the DP services they receive.	1	2	3	4	5	35
c. This city's top management monitors DP expenditures closely.	1	2	3	4	5	36
d. This city's top management monitors DP development priorities closely.	1	2	3	4	5	37
e. Computer applications in operating departments really improve the information available to the city's top management.	1	2	3	4	5	38
f. This city's DP installation has very high morale/esprit.	1	2	3	4	5	39
g. This city's DP installation is considered a leader in our geographic area.	1	2	3	4	5	40
h. This city's DP installation has more equipment and staff than it can use.	1	2	3	4	5	41
i. DP management has its own vision of where it wants to go.	1	2	3	4	5	42
j. City's top management is very satisfied with the DP services operating departments receive.	1	2	3	4	5	43
k. City's top management is very satisfied with how the operating departments are using computing.	1	2	3	4	5	44
l. Operating departments are very satisfied with the DP services they receive.	1	2	3	4	5	45
m. Applications in operating departments are designed to provide information to the city's top management.	1	2	3	4	5	46
n. The computing needs of operating departments are better served than are those of top management.	1	2	3	4	5	47
o. When it comes to conflict between meeting the information needs of top management versus those of the operating departments, top management always wins.	1	2	3	4	5	48
p. This city's data processing unit promotes the expansion of computer use in our government's operations.	1	2	3	4	5	49
q. Computer personnel respect department staff opinions about our city's computing needs.	1	2	3	4	5	50
r. Data processing personnel are more intrigued with what the computer can do than with solving the problems of city departments.	1	2	3	4	5	51
s. Data processing staff confuse users by speaking in technical jargon during conversations.	1	2	3	4	5	52
t. Data processing staff are more interested in working on new computer uses than in improving the ones the city now uses.	1	2	3	4	5	53
u. Data processing staff respond effectively to city departments' immediate computing problems and needs.	1	2	3	4	5	54
v. Data processing staff respond effectively to operating departments' longer term computing problems and needs.	1	2	3	4	5	55
w. Data processing staff generally are not user-oriented.	1	2	3	4	5	56

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OPERATIONAL CONTEXT:

23. The functions performed by municipal governments vary from city to city. Please review the following list of functions, and indicate whether each function **is** or **is not** performed by your city.
(CIRCLE ONLY ONE RESPONSE FOR EACH ITEM)

FUNCTION	IS Performed By This City	IS Not Performed By This City	Record 4
I. PUBLIC SAFETY			
a. Police Protection	1	2	12
b. Fire Protection	1	2	13
c. Municipal Court	1	2	14
d. Emergency Preparedness	1	2	15
e. Emergency Medical Services	1	2	16
II. FINANCE AND ADMINISTRATION			
a. Accounting	1	2	17
b. Treasury and Collection	1	2	18
c. Assessment and Recording	1	2	19
d. Budgeting and Management	1	2	20
e. Purchasing and Inventory	1	2	21
f. Personnel	1	2	22
III. GENERAL GOVERNMENT			
a. Data Processing	1	2	23
b. Office Systems	1	2	24
c. Geoprocessing, Computer Mapping & Graphics, Land Records	1	2	25
d. Public Information	1	2	26
e. Public Buildings	1	2	27
f. Clerk/Recorder	1	2	28
g. Central Garage/Motor Pool	1	2	29
h. Other (Specify) ____________	1	2	30
IV. COMMUNITY DEVELOPMENT, PUBLIC WORKS & UTILITIES			
a. Planning and Zoning	1	2	31
b. Housing, Urban Renewal and Community Development	1	2	32
c. Licensing and Code Enforcement	1	2	33
d. Engineering	1	2	34
e. Public Transportation/Traffic Management	1	2	35
f. Streets and Highways	1	2	36
g. Sanitation	1	2	37
h. Water Supply	1	2	38
i. Gas or Electric Utilities	1	2	39
V. HUMAN RESOURCE SERVICES			
a. Public Health	1	2	40
b. Public Welfare	1	2	41
c. Schools/Education	1	2	42
d. Parks/Recreation	1	2	43
e. Vital Statistics	1	2	44
f. Libraries	1	2	45
g. Voter Registration	1	2	46

Thank you for completing this questionnaire. Please provide the following information about yourself, in the event we need to contact you:

____________________ ____________________ (   ) ____________________
name title telephone

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INTERNATIONAL CITY MANAGEMENT ASSOCIATION

UNIVERSITY OF CALIFORNIA, IRVINE

NATIONAL STUDY OF URBAN INFORMATION SYSTEMS

LOCAL GOVERNMENT MANAGERS SURVEY 1985

NATIONAL LEAGUE OF CITIES

GOVERNMENT MANAGEMENT INFORMATION SCIENCES

PUBLIC TECHNOLOGY INC.

CALIFORNIA ARIZONA NEVADA INNOVATION GROUP

FLORIDA INNOVATION GROUP

VIRGINIA INNOVATION GROUP

Dear Respondent:

This questionnaire is intended to gather information about your local government. This survey is part of a nationwide study on local government computing undertaken by the Public Policy Research Organization of the University of California, Irvine. It replicates and extends our national survey of 1975. The 1975 survey resulted in the Municipal Information Systems Directory which many local governments continue to reference. One product of the current questionnaire will be a 1985 version of this Directory.

This questionnaire is primarily concerned with the organizational context of your government and will aid us in better understanding local government computing. We are specifically seeking the views of local government managers, so we would greatly appreciate your taking the time to complete this survey personally. It does not require special knowledge of data processing, since technically-oriented questionnaires have been sent directly to your data processing installation(s). In fact, this questionnaire should be completed even if your government does not currently use computers.

Your responses to this questionnaire will be kept confidential and will be summarized without reference to individuals. In appreciation of your effort, we will send participants executive summaries of data from this survey of managers, as well as from our other survey of data processing installations. In addition, we will send you a complementary copy of the 1985 Municipal Information Systems Directory when it is completed.

This study is being done with the cooperation and endorsement of the International City Management Association, Government Management Information Sciences, the National League of Cities, Public Technology Incorporated, the California Arizona Nevada Innovation Group, the Virginia Innovation Group, and the Florida Innovation Group. Findings from the study will be disseminated through the newsletters and publications of these associations and through articles in professional journals.

Thank you for your time and participation. If you have any problems or questions concerning the completion of this questionnaire, please feel free to call us collect at (714) 856-5449. We would appreciate it if you could return the questionnaire within the next two weeks. A return envelope is enclosed for your convenience.

Sincerely,

Kenneth L. Kraemer

Professor Kenneth L. Kraemer

PUBLIC POLICY RESEARCH ORGANIZATION

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Record 1

QUESTIONNAIRE	☐☐☐☐☐	1-5
DEPARTMENT	☐☐	6-7
CITY/COUNTY	☐☐☐☐	8-11

THE MUNICIPAL CONTEXT OF DATA PROCESSING

LEVEL OF MANAGEMENT DECISIONS:

1. The following is a list of common decisions made in an organization such as yours. For each decision listed, please indicate the ***lowest level in the organization*** which can make that decision. Please do not include staff agencies, such as a Civil Service Commission, which give final approval to decisions actually reached at other levels. Please choose the appropriate ***lowest*** level for each of the following decisions: (CIRCLE ***ONE*** NUMBER IN EACH ROW.)

Decision:	City Council or Commission (Legislature)	City Manager or Top Admin Officer	Assistant or Deputy City Manager	Department Head	Division Head	Supervisor (e.g., police sergeant or chief billing clerk)	Direct worker (e.g., policeman or billing clerk)	
A. Determine how many supervisors are needed	1	2	3	4	5	6	7	12
B. Appoint supervisory staff from outside the organization	1	2	3	4	5	6	7	13
C. Promote supervisory staff	1	2	3	4	5	6	7	14
D. Set salaries of supervisory staff	1	2	3	4	5	6	7	15
E. Spend unbudgeted or unallocated money on capital items	1	2	3	4	5	6	7	16
F. Spend unbudgeted or unallocated money on non-capital items	1	2	3	4	5	6	7	17
G. What type, or what brand, new equipment is to be	1	2	3	4	5	6	7	18
H. Determine a new service	1	2	3	4	5	6	7	19
I. Determine service areas covered	1	2	3	4	5	6	7	20

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2

Decision:	City Council or Commission (Legislature)	City Manager or Top Admin Officer	Assistant or Deputy City Manager	Department Head	Division Head	Supervisor (e.g., police sergeant or chief billing clerk)	Direct worker (e.g., policeman or billing clerk)	Record 1
J The extent and type of services to be delivered	1	2	3	4	5	6	7	21
K. What will be costed	1	2	3	4	5	6	7	22
L. What will be inspected in the government	1	2	3	4	5	6	7	23
M. What operations are targetted for productivity evaluation	1	2	3	4	5	6	7	24
N. Dismiss a supervisor	1	2	3	4	5	6	7	25
O. Training methods to be used	1	2	3	4	5	6	7	26
P. Buying procedures	1	2	3	4	5	6	7	27
Q. Which suppliers of materials are to be used	1	2	3	4	5	6	7	28
R. What and how many employee facilities and services are to be provided	1	2	3	4	5	6	7	29
S Level of user fees	1	2	3	4	5	6	7	30
T. Alter responsibilities/ areas of work of staff departments	1	2	3	4	5	6	7	31
U. Alter responsibilities/ areas of work of line departments	1	2	3	4	5	6	7	32
V. Create a new department	1	2	3	4	5	6	7	33
W. Create a new job	1	2	3	4	5	6	7	34

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3

DATA PROCESSING CONTEXT:

Record 1

2. Which description below *best* describes the current role of data processing management in this government? (PLEASE BE SURE TO CIRCLE ONLY ONE NUMBER.)

Introduce technological innovation and educate top managers and users on the future of data processing	1	
Carry out directives of top management and coordinate data processing activity	2	35
Work with top management to determine data processing directions and translate user requirements into systems	3	
The role of data processing management is in transition and at present is unclear	4	

3. Please rank the relative importance of the following data processing tasks to this government for the current year. Number '1' is most important and number '6' is least important. (ENTER RANK NUMBER IN EACH BOX.)

A.	Integrating data processing and telecommunications	☐	36
B.	Installing office automation (e.g., word processing, electronic mail, etc.)	☐	37
C.	Revamping old systems	☐	38
D.	Expanding data processing within departments/areas that currently use computing	☐	39
E.	Expanding data processing to departments/areas that do not now use computing	☐	40
F.	Keeping existing administrative systems running and current	☐	41
G.	Installing local area networks	☐	42

4. What is the *primary* purpose of your government's DP Planning activities? (CIRCLE ONE NUMBER ONLY.)

Minimize expenditures on hardware and software	1	
Meet growing user demand	2	43
Stay at leading edge of the technology	3	
Establish or clarify the role of DP in the organization	4	

5. Which statement *best describes* your government's method for managing technological change? (CIRCLE ONE NUMBER ONLY.)

Mainstream, stay with proven technologies	1	
Maintain base of proven technologies, and experiment with selected new technologies	2	44
Adopt a wide range of advanced technologies as they emerge	3	
Develop entirely new technologies in-house	4	

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VIEWS ON DATA PROCESSING:

Record 1

6. Please circle the one number in each row which best describes your agreement or disagreement with each of the following statements. (CIRCLE ONE NUMBER IN EACH ROW.)

	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Don't Know	
A. This government's data processing unit promotes the expansion of computer use in our government operations	1	2	3	4	7	45
B. Computer personnel respect department staff opinions about our city's computing needs	1	2	3	4	7	46
C. Data processing personnel are more intrigued with what the computer can do than with solving the problems of city departments	1	2	3	4	7	47
D. Data processing staff confuse user conversations with their technical language	1	2	3	4	7	48
E. Data processing staff are more interested in working on new computer uses rather than making improvements in ones the city now uses	1	2	3	4	7	49
F. Data processing staff respond effectively to city departments' immediate computing problems and needs	1	2	3	4	7	50
G Data processing staff respond effectively to city departments' longer term computing problems and needs	1	2	3	4	7	51
H Data processing staff generally are not user-oriented	1	2	3	4	7	52

EMERGING INFORMATION TECHNOLOGY:

7 A new potential for information handling is provided by cable television facilities. Are any cable television channels now used by your local government?

Yes 1 53

No (SKIP TO Q 9) 2

8. For what kinds of things do you use cable television facilities? (CIRCLE ONE NUMBER IN EACH ROW)

	Yes	No	
A. Transmit data between city offices and facilities	1	2	54
B. Broadcast council meetings	1	2	55
C. Broadcast a government events calendar	1	2	56
D Broadcast a community events calendar	1	2	57
E. Two-way communication with citizens, e.g polling, teleconferencing	1	2	58
F Staff training	1	2	59

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5

THE FUTURE OF INFORMATION SYSTEMS: THE 1990's

9. The following are a series of ***predictions*** about local government computing ***five years from now.*** For each prediction, please indicate the extent to which you agree or disagree with the prediction. (CIRCLE ONE NUMBER IN EACH ROW.) Record 2

Five years from now:	Strongly Disagree	Disagree	Agree	Strongly Agree	
A. Federal programs and funding will have a negligible impact on local government computing.	1	2	3	4	12
B. Local governments will be increasingly pressured to participate in State-wide information systems.	1	2	3	4	13
C. The DP Manager's organizational role will evolve into that of the Chief Executive Officer.	1	2	3	4	14
D. An increasing number of DP Managers will be promoted to the position of Chief Executive Officer.	1	2	3	4	15
E. Maintaining core administrative computing (e.g., finance, revenue collection, personnel/payroll system) will be the top priority.	1	2	3	4	16
F. Meeting new end user demands will be the top DP priority.	1	2	3	4	17
G. Computing use will be expanded beyond the functional areas now involved with computing.	1	2	3	4	18
H. Systems integration will be the primary goal of systems expansion.	1	2	3	4	19
I. Systems will be increasingly adopted or developed to meet individual end users' needs.	1	2	3	4	20
J. End user computing growth will be limited to functional areas now using computing.	1	2	3	4	21
K. End user computing growth will include personnel in all the organization's functional areas	1	2	3	4	22
L. Information centers, "computer stores", and office support groups will become major means for defining end user needs.	1	2	3	4	23
M. Information centers, "computer stores", and office support groups will be managed by DP.	1	2	3	4	24
N. End user understanding of computing and its uses will increase substantially.	1	2	3	4	25
O. While computer literacy will spread through the organization, technical expertise will reside within DP.	1	2	3	4	26
P Dedicating mainframe and minicomputers to specific applications will become common practice.	1	2	3	4	27
Q. Obtaining turnkey systems will become a common solution to specific user needs.	1	2	3	4	28
R. The costs of modifying turnkey systems to fit organizational needs will greatly reduce their use.	1	2	3	4	29
S. The need for systems integration will require that many turnkey applications and dedicated systems be returned to central mainframes.	1	2	3	4	30
T. End user computing will generate a greater need for large central mainframes.	1	2	3	4	31
U. Most work will be performed on powerful workstations rather than mainframes.	1	2	3	4	32
V. Organizations will obtain their equipment from one or from very few vendors	1	2	3	4	33

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6

Five years from now:	Strongly Disagree	Disagree	Agree	Strongly Agree	Record 2
W. As new equipment is adopted, older equipment will be increasingly handed-down within the organization, thereby expanding access to computing.	1	2	3	4	34
X. Vendor maintenance and support will outweigh hardware performance as a purchase criterion.	1	2	3	4	35
Y. User-friendly operating systems will be favored over those which are technically superior.	1	2	3	4	36
Z Ensuring system compatibility will be a major responsibility of DP.	1	2	3	4	37

10 Please rank the following tasks according to their likely importance to this installation in five years. Number '1' will be most important and number '7' will be least important. (ENTER RANK NUMBER IN EACH BOX.)

A. Microcomputer acquisitions	☐	38
B. Office automation projects	☐	39
C. Telecommunications enhancements	☐	40
D. Central facility operations	☐	41
E. Mainframe/minicomputer/microcomputer linkages	☐	42
F. Local Area Network developments	☐	43
G Turnkey application purchases	☐	44

11 Rank the following application areas in order of their likely growth in your organization ***over the next five years,*** with number '1' likely to experience the greatest growth and number '8' likely to experience the least growth (ENTER RANK NUMBER IN EACH BOX.)

A. Public Safety	☐	45
B Finance	☐	46
C Administration	☐	47
D. Data Processing	☐	48
E. Community Development	☐	49
F. Public Works	☐	50
G. Utilities	☐	51
H. Human Resources	☐	52

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Thank you for completing the questionnaire. If there are any comments you would like to make, please use the space provided below. Please check for any unanswered questions, place in the return envelope, and mail as soon as conveniently possible to:

National Study Of Urban Information Systems
Public Policy Research Organization
University of California
Irvine, California 92717

Also, please provide the names and titles of those persons who completed this questionnaire.

Name	Title	Phone
Name	Title	Phone
Name	Title	Phone

Respondent's Comments

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Appendix C

Reliability and Factor Analyses for the

Structure of Organizational Decision Measure

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A) Reliability of the Structure of Organizational Decision Measure

Item-total Statistics

Item # ("Local Gov. Survey")	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multi-ple correlation	Alpha if item deleted
ACM1A	65.5019	192.4239	.4414	.3301	.8574
ACM1B	65.5506	199.4965	.2786	.4817	.8626
ACM1C	56.0412	198.2727	.3591	.5394	.8600
ACM1D	66.5655	195.7504	.3782	.2967	.8595
ACM1E	66.8764	196.1313	.4252	.7107	.8581
ACM1F	66.5318	193.1973	.4081	.7014	.8586
ACM1G	64.4644	193.5955	.4786	.3911	.8564
ACM1H	65.9775	184.8942	.5852	.6070	.8519
ACM1I	65.6779	184.7981	.6047	.5944	.8512
ACM1J	66.1049	184.5529	.6152	.5090	.8509
ACM1K	65.6169	189.2131	.5399	.4543	.8540
ACM1L	65.5618	190.5027	.4620	.4012	.8567
ACM1M	65.3558	192.6210	.4504	.3575	.8571
ACM1N	65.0787	198.2532	.3574	.4515	.8600
ACM1O	64.2809	196.6840	.4634	.3612	.8573
ACM1P	65.5393	198.1667	.2539	.1710	.8644
ACM1Q	64.4045	191.2643	.4771	.3482	.8562
ACM1R	66.2360	192.8576	.4612	.3272	.8568
ACM1S	66.7416	189.9367	.4852	.3603	.8559
ACM1T	65.6816	197.7141	.3263	.4770	.8611
ACM1U	65.7378	198.1791	.2930	.4687	.8624
ACM1V	67.2884	204.8301	.3349	.2516	.8615
ACM1W	66.4345	193.0060	.4269	.3555	.8579

Reliability coefficients: Alpha = .8631 Standardized Alpha = .8630

B) Factor Analysis of the Structure of Organizational Decision Measure

Initial Statistics

Variable ("Local Gov. Survey")	Communality	Factor	Eigenvalue	Percent of variance	Cumulative percent
ACM1A	1.00000	1	5.94765	25.9	25.9
ACM1B	1.00000	2	2.51148	10.9	36.8
ACM1C	1.00000	3	1.63879	7.1	43.9
ACM1D	1.00000	4	1.51139	6.6	50.5
ACM1E	1.00000	5	1.21967	5.3	55.8
ACM1F	1.00000	6	1.09792	4.8	60.6
ACM1G	1.00000	7	.90521	3.9	64.5
ACM1H	1.00000	8	.85397	3.7	68.2
ACM1I	1.00000	9	.82149	3.6	71.8
ACM1J	1.00000	10	.79798	3.5	75.2
ACM1K	1.00000	11	.69605	3.0	78.3
ACM1L	1.00000	12	.67891	3.0	81.2
ACM1M	1.00000	13	.57648	2.5	83.7
ACM1N	1.00000	14	.53216	2.3	86.0
ACM1O	1.00000	15	.47570	2.1	88.1
ACM1P	1.00000	16	.46093	2.0	90.1
ACM1Q	1.00000	17	.44589	1.9	92.1
ACM1R	1.00000	18	.41355	1.8	93.8
ACM1S	1.00000	19	.40122	1.7	95.6
ACM1T	1.00000	20	.34567	1.5	97.1
ACM1U	1.00000	21	.27005	1.2	98.3
ACM1V	1.00000	22	.24282	1.1	99.3
ACM1W	1.00000	23	.15502	.7	100.0

Principal components analysis extracted 6 factors.

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Final Statistics

Variable: Local Government Survey	Communality	Factor	Eigenvalue	Percent of variance	Cumulative percent
ACM1A	.43080	1	5.94765	25.9	25.9
ACM1B	.63826	2	2.51148	10.9	36.9
ACM1C	.65834	3	1.63879	7.1	43.9
ACM1D	.50093	4	1.51139	6.6	50.5
ACM1E	.89379	5	1.21967	5.3	55.8
ACM1F	.88588	6	1.09792	4.8	60.6
ACM1G	.53324				
ACM1H	.72468				
ACM1I	.71625				
ACM1J	.63216				
ACM1K	.58629				
ACM1L	.49599				
ACM1M	.51169				
ACM1N	.67064				
ACM1O	.50717				
ACM1P	.51622				
ACM1Q	.56954				
ACM1R	.40228				
ACM1S	.49738				
ACM1T	.72802				
ACM1U	.73277				
ACM1V	.50591				
ACM1W	.58867				

Rotated Factor Matrix

Varimax converged in 7 iterations

	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6
ACM1A	.17778	.38903	.47688	.00472	.11245	.08817
ACM1B	-.06275	.75718	.17911	-.10907	.11149	.06777
ACM1C	.08200	.76595	.15144	-.15339	.07090	.11596
ACM1D	.13320	.25500	.63555	-.03146	.11214	-.02593
ACM1E	.18586	.12249	.12709	-.01044	.90924	.03543
ACM1F	.13401	.05044	.12281	.04987	.91136	.13130
ACM1G	.23707	.34426	.08673	.02444	.06887	.58792
ACM1H	.82103	.06973	.17172	.00296	.08291	.09676
ACM1I	.80501	.12005	.18938	-.01942	.09527	.09208
ACM1J	.72846	.07642	.19611	.19040	.12943	.06483
ACM1K	.61467	-.01694	.06260	.07367	.09368	.43596
ACM1L	.48954	.03846	-.00822	.29400	-.06353	.40538
ACM1M	.41188	.26922	-.13414	.48286	.08471	.10599
ACM1N	.03886	.78274	.20670	.10763	-.03343	-.03186
ACM1O	.38433	.53215	-.10497	.18443	.03570	.17315
ACM1P	-.00639	-.11155	.15186	.14410	.03547	.67724
ACM1Q	.24206	.24780	.04097	.06868	.10354	.65759
ACM1R	.45453	.03309	.10806	.30716	.29683	.02149
ACM1S	.37557	-.03165	.46775	.33479	.15635	.00083
ACM1T	.17390	-.05379	.03591	.82960	.01266	.07210
ACM1U	.00324	-.08994	.19073	.81061	-.01097	.17633
ACM1V	.07306	-.01444	.67930	.08595	-.02771	.17538
ACM1W	.09676	.20240	.71732	.06019	.11929	.07712

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Appendix D

List of Cities with Multiple Installations

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Name	Department of the installation	Year started	Annual DP budget (000$)	Staff (FTE)
Chula Vista, CA	Management Services	1971	389	6 **
	Library	1979	—	—
Hayward, CA	Independent	1970	686	7 **
	Police	1981	—	3
Los Angeles, CA	Independent	1967	300,000	383 **
	Airport	1965	—	10
Oakland, CA	Finance	1963	2,300	37 **
	Police	1971	528	5
	General services	1984	250	3
Riverside, CA	Finance	1960	1,170	20 **
	Library	1984	183	3
	Police	1978	—	14
Sacramento, CA	Independent	1971	1,794	28 **
	General services	1982	200	1
	Police	1981	843	20
San Francisco, CA	Controller	1961	23,005	301 **
	Utility	—	5,000	75
	Public health	1979	7,500	85
	Police	1983	3,200	29
	Court	1979	1,606	14
Denver, CO	Management and budget	1957	10,988	126 **
	Water	1976	3,329	46
Washington, DC	Finance	1979	9,751	166 **
	Planning	1964	280	5
	Employment services	—	2,500	86
Boise City, ID	Finance	1976	654	12 **
	Library	1975	1,300	1
Chicago, IL	Management and budget	1968	9,800	203 **
	Police	1962	4,500	125
Cedar Rapids, IA	Independent	1969	354	10 **
	Police	1984	15	2
Wichita, KS	Regional installation	1976	3,428	61 **
	Court	1980	210	5
Baltimore, MD	Finance	1955	4,556	135 **
	Police	1968	1,300	15
	Fire	1979	—	3
	Public works	1966	900	14
Flint, MI	Finance	1958	1,740	27 **
	Police	1979	155	33
Lansing, MI	Administrative services	1972	1,200	18 **
	Police	1977	250	2
Warren, MI	Controller	1968	435	7 **
	Police	1979	75	6
Bloomington, MN	Staff services	1972	390	8 **
	Police	1982	—	2
Rochester, MN	Finance	1971	250	5 **
	Utility	1983	285	5

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St. Paul, MN	Finance	1976	18,000	19 **
	Water	1980	—	2
	Public works	1979	300	5
	City council	1983	—	—
Omaha, NE	Finance	1965	268	8 **1
	Independent	1968	3,457	68
Rochester, NY	Independent	1967	2,300	44 **
	Public works	1981	—	2
Asheville, NC	Finance	1971	443	13 **
	Regional installation	1978	—	78
Oklahoma City, OK	Finance	1956	2,550	37 **
	Fire	1976	—	2
	Public services	1984	—	3
	Community development	1981	—	6
Philadelphia, PA	Finance	1960	10,928	158 **
	Court	1968	—	40
	Board of revision-taxes	1982	—	—
Amarillo, TX	Finance	1954	1,106	16 **
	Police	1983	40	1
Bloomington, IN	Controller	1980	200	4 **
	Utility	1979	383	3
Iowa City, IA	Finance	1981	142	3 **
	Library	1979	81	5

** : The installation chosen to represent the city-wide measure of the structure of computing decision authority.
FTE : Full time equivalent
— : Missing data

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Endnotes

1. Omaha has a peculiar structural arrangement. Most important computing decisions are made in the installation in the finance department. The installation in the independent DP department, although it has a larger budget and more staff, deals mainly with operational matters. The Finance installation provides a better indication of who makes and influences major computing decisions, and thus better reflects how centralized computing authority is in the city.

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Appendix E

Reliability and Factor Analyses for the Structure of Computing Authority Measure

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A) Reliability of the Structure of Computing Decision Measure

Item-total Statistics

Item # ("DP Mgmt and Plng Survey")	Scale mean if item deleted	Scale variance if item deleted	Corrected item-total correlation	Squared multiple correlation	Alpha if item deleted
DPM15A	13.7547	13.4846	.4369	.3101	.5722
DPM15B	13.8255	14.0405	.3609	.2528	.5986
DPM15C	12.2170	12.2750	.4340	.2234	.5682
DPM15D	12.9906	12.0473	.4553	.2438	.5586
DPM15E	13.1651	15.3518	.1966	.0701	.6519
DPM15F	12.3491	13.8491	.3326	.1327	.6086

Reliability coefficients: Alpha = .6385 Standardized Alpha = .6345

B) Factor Analysis of the Structure of Computing Decision Measure

Initial Statistics

Variable ("Local Government Survey")	Communality	Factor	Eigenvalue	Percent of variance	Cumulative percent
DPM15A	1.00000	1	2.17632	36.3	36.3
DPM15B	1.00000	2	1.11304	18.6	54.8
DPM15C	1.00000	3	.89895	15.0	69.8
DPM15D	1.00000	4	.73459	12.2	82.0
DPM15E	1.00000	5	.61729	10.3	92.3
DPM15F	1.00000	6	.45982	7.7	100.0

Principal components analysis extracted 2 factors.

Final Statistics

Variable ("Local Government Survey")	Communality	Factor	Eigenvalue	Percent of variance	Cumulative percent
DPM15A	.69789	1	2.17632	36.3	36.3
DPM15B	.60887	2	1.11304	18.6	54.8
DPM15C	.45735				
DPM15D	.49272				
DPM15E	.48940				
DPM15F	.54313				

Rotated Factor Matrix

Varimax converged in 3 iterations

	Factor 2	Factor 3
DPM15A	.83440	.04078
DPM15B	.77993	-.02418
DPM15C	.51321	.44041
DPM15D	.46955	.52177
DPM15E	-.09374	.69326
DPM15F	.11530	.72790

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Appendix F

Main SPSSX Programs

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```
/* Program to construct and test the different indexes.
file handle input name = 'midmgmt zinary a'
file handle output name = 'midmgmt binary a'
get file = input
select if (pop80 ge 50000)
select if (dpm1 = 1) or (dpm1 = 2)
if (cityid eq 3) or (cityid eq 63) or (cityid eq 100) or (cityid eq 101) or (cityid eq
        158) or (cityid eq 371) cm3d eq 9999
/*
/* Section to construct and test the index of centralization of computing authority
do if dpm1 = 1
recode dpm15a to dpm15f (3=2) (4=3) (5=3)
end if
do if dpm1 = 2
recode dpm15a to dpm15f (3=1) (2=3) (4=3) (1=2)
end if
recode dpm15a to dpm15f (6=9)
reliability variables = dpm15a to dpm15f/
        scale (influen) = all/
statistics 1 3 4 9
factor variables = dpm15a to dpm15f/
        analysis = all/
        extraction = pa1/
        rotation = varimax/
compute influen = sum (dpm15a to dpm15f)
/*
/* Section to construct and test the index of centralization of organizational /*
authority
reliability variables = cam1a to acm1w/
        scale (central) = all/
statistics 1 3 4 9
factor variables = acm1a to acm1w/
        analysis = all/
        extraction = pa1/
        rotation = varimax/
compute central = sum.23 (acm1a to acm1w)/nvalid (acm1a to acm1w)
/*
/* Section to compute the control applications index
count temp1 = aqa24op to aqa26op aqa33op aqa34op aqa38op to aqa42op
        aqb4op to aqb6op aqb11op aqb12op aqb16op to aqb21op aqc21op to
        aqc23op aqe1op aqe2op aqe6op to aqe8op aqf1op to aqf10op aqg1op
        aqg2op aqg4op aqi3op to aqi10op aqi12op aqi13op aqi15op aqj1op to
        aqj4op aqj7op aqj8op aqk1op aqp2op aqr1op to aqr5op aqt1op aqu5op
        aqv4op to aqv10op aqw4op aqw5op aqy1op aqy4op to aqy7op aqz1op
        aqz6op aqz14op aqaa8op aqbb1op aqbb3op aqbb5op aqbb9op to aqbb13op
        aqbb16op aqbb18op aqbb22op to aqbb26op aqbb29op aqbb31op aqbb35op
```

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```
    to aqbb39op aqcc7op aqcc29op aqdd4op aqee1op aqee6op aqee8op
    aqee9op aqgg10op (1)/
compute control = temp1/totop
/*
/* Section to compute the coordination applications index
count temp2 = aqn1op to aqn5op (1)
compute coordi = temp2/totop
/*
/* Section to compute the efficiency applications index
count temp3 = aqm1op to aqm6op aqm9op aqm10op
compute effici = temp3/totop
/*
/* Section to compute the access index
compute access = (dpm37b1 + termtot)/emps85
/*
/* Section to compute the ratio of middle managers
compute ratiomm = (cm3c + cm3d)/(cm3a + cm3b + cm3c + cm3d)
/*
/* Section to compute the control variable size
compute logemp = lg10 (emps85)
/*
/* Section to compute the uncorrected interaction terms
compute continf = control * influen
compute coordinf = coordi * influen
compute effinf = effici * influen
compute acceinf = access * influen
/*
/* Section to keep only the 155 cities that will be used in the regression analyses
/* (through the listwise deletion of cases). This is done to have a consistency in
/* the sample used in the T-Test, multicollinearity, correlation analyses.
count qmiss = ratiomm control coordi effici access logemp influen (missing)/
select if (qmiss = 0)
save outfile = output/map
finish
```

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```
/* Program to test differences between the study sample and URBIS sample
file handle input name = 'midmgmt binary a'
get file input
compute numm = cm3c + cm3d
compute numgmt = cm3a + cm3b + cm3c + cm3d
compute ratiomm = numm/numgmt
compute intopt = sum (cm17a2 to cm17n2)
count function = cm23a to cm23hh (1)/
compute fisopt = sum (cm17a3 to cm17p3)
compute extopt = sum (cm17a1 to cm17f1)
compute dpbudget = dpm28
compute dpstaff = dpm32
/*
/* The number of installation (numinst), government type (govtype), revenues
/* (rev85), the expenditures (expend85), the total number of applications in
/* operation (totop), the index of centralization of computing authority
/* (influence), control applications (control), coordination (coordi), efficiency
/* (effici), and the access variable (access) were constructed previously and
/* already exist.
count qmiss = ratiomm control coordi effici access logemp influen (missing)/
do if qmiss = 0
compute temp = 1
end if
do if qmiss <> 0
compute temp = 2
end if
t-test groups = temp/variables = emps85 govtype influen numm numgmt
ratiomm     intopt function dpbudget dpstaff fisopt extopt pop80 rev85 expend85
            numinst totop control coordi effici access
finish
```

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```
/* Program to test differences between the two sub-samples.
file handle input name = 'midmgmt binary a'
get file input
compute numm = cm3c + cm3d
compute numgmt = cm3a + cm3b + cm3c + cm3d
compute ratiomm = numm/numgmt
compute intopt = sum (cm17a2 to cm17n2)
compute fisopt = sum (cm17a3 to cm17p3)
compute extopt = sum (cm17a1 to cm17f1)
compute dpbudget = dpm28
compute dpstaff = dpm32
/*
/* The number of installation (numinst), government type (govtype), revenues
/* (rev85), the expenditures (expend85), the total number of applications in
/* operation (totop), the index of centralization of computing authority
/* (influence), control applications (control), coordination (coordi), efficiency
/* (effici), the access variable (access), and the index of centralization of
/* organization authority were constructed previously and already exist.
recode central (0 thru 12=1) (3.0001 thru hi=2)
t-test groups = central/variables = emps85 govtype numm numgmt ratiomm
        intopt extopt fisopt dpbudget dpstaff pop80 rev85 expend85 control coordi
        effici access totop influen numinst
finish
```

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```
/* Program to test for multicollinearity for the overall sample.
File handle input name = 'midmgmt binary a'
get file input
/*
/* Section to test collinearity with the uncorrected interaction terms.
pearson corr ratiomm control coordi effici access continf coordinf effinf acceinf/
        statistics all
regression
        variables = control coordi effici access continf coordinf effinf acceinf
        influen/
        dependent = control/ enter/
        dependent = coordi/ enter/
        dependent = effici/ enter/
        dependent = access/ enter/
        dependent = continf/ enter/
        dependent = coordinf/ enter/
        dependent = effinf/ enter/
        dependent = acceinf/ enter/
        dependent = influen/ enter/
/*
/* Section to test collinearity with the corrected interaction terms.
compute continf = (control - .321) * (influen - 12.442)
compute coordinf = (coordi - .008) * (influen - 12.442)
compute effinf = (effici - .037) * (influen - 12.442)
compute acceinf = (access - .078) * (influen - 12.442)
pearson corr ratiomm control coordi effici access continf coordinf effinf acceinf/
        statistics all
regression
        variables = control coordi effici access continf coordinf effinf acceinf
        influen/
        dependent = control/ enter/
        dependent = coordi/ enter/
        dependent = effici/ enter/
        dependent = access/ enter/
        dependent = continf/ enter/
        dependent = coordinf/ enter/
        dependent = effinf/ enter/
        dependent = acceinf/ enter/
        dependent = influen/ enter/
finish
```

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```
/* Program to test for multicollinearity for organizations with a centralized
/* organizational decision authority structure.
file handle input name = 'midmgmt binary a'
get file input
select if (central le 3.000)
/*
/* Section to test collinearity with the uncorrected interaction terms.
pearson corr ratiomm control coordi effici access continf coordinf effinf acceinf/
        statistics all
regression
        variables = control coordi effici access continf coordinf effinf acceinf
        influen/
        dependent = control/ enter/
        dependent = coordi/ enter/
        dependent = effici/ enter/
        dependent = access/ enter/
        dependent = continf/ enter/
        dependent = coordinf/ enter/
        dependent = effinf/ enter/
        dependent = acceinf/ enter/
        dependent = influen/ enter/
/*
/* Section to test collinearity with the corrected interaction terms.
compute continf = (control - .320) * (influen - 12.733)
compute coordinf = (coordi - .008) * (influen - 12.733)
compute effinf = (effici - .034) * (influen - 12.733)
compute acceinf = (access - .072) * (influen - 12.733)
pearson corr ratiomm control coordi effici access continf coordinf effinf acceinf/
        statistics all
regression
        variables = control coordi effici access continf coordinf effinf acceinf
        influen/
        dependent = control/ enter/
        dependent = coordi/ enter/
        dependent = effici/ enter/
        dependent = access/ enter/
        dependent = continf/ enter/
        dependent = coordinf/ enter/
        dependent = effinf/ enter/
        dependent = acceinf/ enter/
        dependent = influen/ enter/
finish
```

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```
/* Program to test for collinearity for organizations with a decentralized
/* organizational decision authority structure.
file handle input name = 'midmgmt binary a'
get file handle input
select if (central gt 3.000)
/*
/* Section to test collinearity with the uncorrected interaction terms.
pearson corr ratiomm control coordi effici access continf coordinf effinf acceinf/
        statistics all
regression
        variables = control coordi effici access continf coordinf effinf acceinf
       influen/
        dependent = control/ enter/
        dependent = coordi/ enter/
        dependent = effici/ enter/
        dependent = access/ enter/
        dependent = continf/ enter/
        dependent = coordinf/ enter/
        dependent = effinf/ enter/
        dependent = acceinf/ enter/
        dependent = influen/ enter/
/*
/* Section to test collinearity with the corrected interaction terms.
compute continf = (control - .321) * (influen - 12.074)
compute coordinf = (coordi - .009) * (influen - 12.074)
compute effinf = (effici - .041) * (influen - 12.074)
compute acceinf = (access - .086) * (influen - 12.074)
pearson corr ratiomm control coordi effici access continf coordinf effinf acceinf/
        statistics all
regression
        variables = control coordi effici access continf coordinf effinf acceinf
       influen/
        dependent = control/ enter/
        dependent = coordi/ enter/
        dependent = effici/ enter/
        dependent = access/ enter/
        dependent = continf/ enter/
        dependent = coordinf/ enter/
        dependent = effinf/ enter/
        dependent = acceinf/ enter/
        dependent = influen/ enter/
finish
```

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```
/* Program to perform the hierarchy of regressions for the overall sample using
/* the corrected interaction terms
file handle input name = 'midmgmt binary a'
get file handle input
compute continf = (control - .321) * (influen - 12.442)
compute coordinf = (coordi - .008) * (influen - 12.442)
compute effinf = (effici - .037) * (influen - 12.442)
compute acceinf = (access - .078) * (influen - 12.442)
regression
        descriptives = defaults corr sig/
        variables = ratiomm control coordi effici access continf coordinf effinf
       acceing influen logemp/
        dependent = ratiomm/ enter control coordi effici access logemp/
        dependent = ratiomm/ enter control coordi effici access influen logemp/
        dependent = ratiomm/ enter/
/*
/* Section to perform the residuals analysis.
        resid = default id (cityid)/
        casewise = default all level zresid sdresid cook manal/
        scatterplot (*res, *pre)/ partialplot/
        save pred (pred1), resid (resid1)/
plot title = 'residual against ratiomm'/
        vertical = 'residual'/
        horizontal = 'ratio of middle level managers'/
        plot = pred1 with ratiomm; resid1 with ratiomm/
finish
```

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```
/* Program to perform the hierarchy of regressions for organizations with a
/* centralized organizational decision authority structure
file handle input name = 'midmgmt binary a'
get file handle input
select if (central le 3.000)
compute continf = (control - .320) * (influen - 12.733)
compute coordinf = (coordi - .008) * (influen - 12.733)
compute effinf = (effici - .034) * (influen - 12.733)
compute acceinf = (access - .072) * (influen - 12.733)
regression
        descriptives = defaults corr sig/
        variables = ratiomm control coordi effici access continf coordinf effinf
         acceing influen logemp/
        dependent = ratiomm/ enter control coordi effici access logemp/
        dependent = ratiomm/ enter control coordi effici access influen logemp/
        dependent = ratiomm/ enter/
finish
```

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```
/* Program to perform the hierarchy of regressions for organizations with a
/* decentralized organizational decision authority structure
file handle input name = 'midmgmt binary a'
get file handle input
select if (central gt 3.000)
compute continf = (control - .321) * (influen - 12.074)
compute coordinf = (coordi - .009) * (influen - 12.074)
compute effinf = (effici - .041) * (influen - 12.074)
compute acceinf = (access - .086) * (influen - 12.074)
regression
        descriptives = defaults corr sig/
        variables = ratiomm control coordi effici access continf coordinf effinf
         acceing influen logemp/
        dependent = ratiomm/ enter control coordi effici access logemp/
        dependent = ratiomm/ enter control coordi effici access influen logemp/
        dependent = ratiomm/ enter/
finish
```

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Appendix G

Interview Guides

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Overall Case Analysis Content Guide

1. CONTEXT

1.1 General comparative information.

1.1.1 Characteristics of the organization.

a. Government type (Mayor, City manager, Commission)
b. Number of commissioners (councilors)
c. Structure of the organization (number of department)
d. Number of employees (over the last 5 years) (see matrix)
  . Total number
  . Number of top managers
  . Number of middle managers
  . Number of operations managers
  . Number of operations employees
  . Number of office employees
  . Other
e. Population
f. Annual operating budget

1.1.2 Characteristics of computing environment.

a. What is the general role of DP in the overall organization (present and future)?
b. What is the orientation of computing efforts (present and future)?
  . (1) increase quality: management operations efficiency,
  or . (2) increase control and decrease cost: decrease management and operations personnel, control expenditure.
c. What is the focus of DP (present and future)? e.g. focus on any particular level (top, middle, operations); focus on any particular functional area...)
d. Budget ($)
e. Structure of the DP department (Analysts, designers, programmers ...).
f. Equipment (mainframe, minis, micros)
g. Back log (time, number of applications), solution?
h. Main issues

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1.2 Recent evolution (over the last 5 years).

1.2.1 Organization.

a. External (over the last 5 years)

. Change in revenue (federal, state, municipal)

. Change in the legislation that significantly affects the organization and/or DP.

. Other

b. Internal (over the last 5 years)

. Change in the managerial structure (CM or mayor, ACM, DP manager...)

. Change in departmental structure (new departments, fusion of existing departments...).

. Other

1.2.2 Data processing (over the last 5 years)

a. New DP manager

b. New policy, standards, rules, procedures

c. New mainframe

d. Other

2. DETERMINISM DIMENSION

2.1. Information Technology.

2.1.1 Perceived state of the art (sophistication)

a. Usage of the state of the art information technology?

b. Fully "utilize" available technology (especially with regard to possible applications at middle management level)?

2.1.2 Extent of automation (see matrix)

a. Number of applications in operation

b. Horizontal and vertical automation (i.e.across departments = allocation of automation by % in each department; and across the hierarchy levels = allocation of automation by % in each management level.

c. Allocation of PCs and terminals across departments and hierarchical levels.

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2.2 Middle Managers.

2.2.1 General roles: top-middle-operations

2.2.2 Specific middle managers' roles:

a. Interpersonal roles

- . Figurehead (Ceremonial nature, representative of your unit for external events, e.g. mayor's reception, tour visitors for other units or cities)
- . Leader (Direct and indirect efforts to motivate subordinate to attain organization's objectives)
- . Liaison (Make contacts outside hierarchical chain of command e.g. peers of other units, departments, organizations).

b. Informational roles

- . Monitor (scan environment and other units for information, and also monitor the work of employees below you)
- . Disseminator (information link between you superior and subordinates)
- . Spokesman (send information outside your unit e.g. report to people who control your unit, user (for DP), mayor, councilors...).

c. Decisional roles

- . Entrepreneur (try to change and ameliorate your unit)
- . Disturbance handler (resolve conflicts, misunderstandings in and outside your unit)
- . Resources allocator (decide who gets what, authorize decisions)
- . Negotiator (within and across your unit e.g. budget allocation).

***** Allocate one typical day or week of work by % to each role before and after computerization.

***** Use examples.

***** Where (roles) has computing been most applied?

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3. VOLUNTARISM DIMENSION

3.1 Degree of centralization (determine the procedure (how, who, authority needed) to perform the following activities.

3.1.1 General.

a. Managerial
- Decide to create/delete a (1) department, (2) a service, and (3) a position.

b. Personnel
- Decide to hire/fire a supervisor
- Decide to promote a supervisor
- Decide to change the responsibility and authority of a supervisor
- Decide on training method of supervisors

c. Material
- Choose equipment (brand, capacity...)
- Choose a supplier
- Set price limits

d. Monetary
- How much unbudgeted money can be spent at what level without authorization?

3.1.2 Computing decisions (top managers vs middle managers).

a. Planning and priority setting.
- Is there a steering committee? (who are the members, who is the most influential?...)

b. Role of DP manager.
- Carry out directive of top managers

vs. Work with top managers to establish DP orientation

vs . Establish DP orientation.

c. Word middle managers have in computing process (e.g. participate actively, formal authority, influence, successful political actors)

d. Control of computing (operations, minor acquisitions).
- Hardware configuration (PCs vs mainframe...)
- Policy on buying minor equipment, developing minor systems (End user computing at middle manager level?)

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4. PERCEIVED IMPACTS OF INFORMATION TECHNOLOGY

4.1 General roles.

- 4.1.1 Top managers
- 4.1.2 Middle managers
- 4.1.3 Operations managers

4.2 Middle management.

- 4.2.1 Number of middle managers
- 4.2.2 Roles
  - a. Interpersonal
  - b. Informational
  - c. Decisional roles
- 4.2.3 Range/number of decisions

4.3 Degree of centralization.

- 4.3.1 Managerial
- 4.3.2 Personnel
- 4.3.3 Material
- 4.3.4 Monetary

4.4 Vertical and horizontal communication patterns (what is used: IT vs MM).

4.5 Control of communications (who controls communications).

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Respondents

	CM	DH	DP manager	Middle manager	Pers. director
1. CONTEXT					
1.1 General comparative information.					
1.1.1 Characteristics of the organization	a-c, e-f	d			d
1.1.2 Characteristics of the computing environment.	a, b, c		all		
1.2 Recent evolution.					
1.2.1 Organization wise	all				
1.2.2 Data processing			all		
2. DETERMINISM DIMENSION					
2.1. Information Technology.					
2.1.1 Perceived state of the art			all		
2.1.2 Extent of automation			all		
2.2 Middle Managers.					
2.2.1 General: top-middle-operations	all	all			
2.2.2 Specific middle managers' roles				all	
3. VOLUNTARISM DIMENSION					
3.1 Degree of centralization.					
3.1.1 General	all	all			
3.1.2 Computing decisions	a, b, c	a, b, c	all	c, d	
4. PERCEIVED IMPACTS OF IT.					
4.1 General roles.					
4.1.1 Top managers	all				
4.1.2 Middle managers	all				
4.1.3 Operations managers	all				
4.2 Middle management.					
4.2.1 Number		all	all	all	all
4.2.2 Roles		all	all	all	
4.2.3 Range and number of decisions		all	all	all	
4.3 Degree of centralization.					
4.3.1 Managerial	all	all	all	all	
4.3.2 Personnel	all	all	all	all	
4.3.3 Material	all	all	all	all	
4.3.4 Monetary	all	all	all	all	
4.4 Vertical and horizontal communica.	all	all	all	all	
4.5 Control of communications.	all	all	all	all	

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Documents to Analyze

* Organizational charts
    . Overall organization (before and after IT) [CM]
    . Detailed DP chart [DP MANAGER]
    . Detailed chart of the department [DH]

* City budget [CM]

* DP budget [DP MANAGER]

* General job description of Top, Middle, Operations managers. [CM, PERSONNEL DIRECTOR]

* Detailed job description of middle managers (several examples) [MIDDLE MANAGERS]

Legend: [ ] indicates the respondents

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Interview Guide: City Manager

Organization:___________________________ Date:__________

1. INTRODUCTION.

* Purpose and nature of the study.
* Selection of respondents.
* Assure of anonymity.
* May find some questions silly, difficult to answer
* Feel free to interrupt, ask question, clarification.
* My background (origin, training, interests).
* Permission to record
    - permit to focus on interaction,
    - cannot write everything down,
    - easier to reconstitute interview.
* Length of the interview.
* Documentation:
    - Overall org chart (before and after IT).
    - job desc. of middle managers.
    - City budget.

2. RESPONDENT.

Name :______________________________ Phone:____________

Title :___________________________ Since: _______

Job description :____

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Previous position :

Time in organization :

Education :

Other :

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3. CONTEXT.

3.1 Characteristics of the organization.

a. Government type.
b. Number of commissioners (councilors).
c. Structure of the organization (name and number of departments).
d. Population.
e. Annual operating budget.

3.2 General characteristics of computing environment.

a. What is the general role of DP in the overall organization (present and future)?

b. What is the orientation of computing efforts (present and future)?
. (1) increase quality: management operations efficiency,
or . (2) increase control and decrease cost: decrease management and operations personnel, control expenditure),

c. What is the focus of DP (present and future)?
. (1) focus on any particular level (top, middle, operations)?
. (2) focus on any particular functional area?

3.3 Recent evolution.

a. External (change in revenue i.e. federal, state, municipal; change in the legislation that significantly affects the organization and/or DP...).
b. Internal (change in the managerial structure, managerial occupational profile, departmental structure...).

4. TOP-DH-MIDDLE-OPERATIONS MANAGERS.

4.1 Description of roles, functions, responsibilities, focus of attention.

4.2 Where has IT been mostly applied?

4.3 How did IT affect these roles and focus of attention?

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5. DEGREE OF CENTRALIZATION OF DECISION MAKING.

5.1 Determine the procedure (how, who, authority needed) used to perform the following activities.

a. Create/delete a
   - department.
   - service.
   - supervisory position.

b. Decide to hire/fire a supervisor.

c. Decide to promote a supervisor.

d. Decide to change the responsibility and authority of a supervisor.
e. Decide on training method of supervisors.

f. Choose equipment (brand, capacity...).

g. Choose a supplier.

h. Set price limits for equipment (i.e. what limit at what level?).
i. How much unallocated/unbudgeted money can be spent at what level without authorization?

5.2 Impact of IT.

a. Where has IT been mostly applied (control or support any particular set of decisions)?
b. How did IT affect these decisions (centralization vs decentralization?)

8. CONTROL OF COMPUTING DECISIONS (top vs middle managers).

8.1 Is there a steering committee? who are the members?
8.2 Which group, if any, controls computing (top management, middle management, operations management, DP, end users, other).
8.3 What word (formal authority, power, influence) do middle managers have to say in computing decisions (general orientation, operational decisions...).
8.4 Political behavior of middle managers (previous successful upward influencers?)

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9. AFTERTHOUGHTS AND COMMENTS.

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Interview Guide: Department Head

Organization:______________________________ Date:________

1. INTRODUCTION.

* Purpose and nature of the study.
* Selection of respondents.
* Assure of anonymity.
* May find some questions silly, difficult to answer
* Feel free to interrupt, ask question, clarification.
* My background (origin, training, interests).
* Permission to record
    - permit to focus on interaction,
    - cannot write everything down,
    - easier to reconstitute interview.
* Length of the interview.
* Documentation:
    - Detailed organizational chart of the department.

2. RESPONDENT.

Name :________________________________ Phone:____________

Title :______________________________ Since: _______

Job description :____

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Previous position :

Time in organization :

Education :

Other :

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A: ORGANIZATION

3. GENERAL DH-MIDDLE-OPERATIONS MANAGERS.

3.1 Description of roles, functions, responsibilities, focus of attention.

3.2 At what level has IT been mostly applied?

3.3 How did IT affect these roles and focus of attention?

4. DEGREE OF CENTRALIZATION OF DECISION MAKING

4.1 Determine the procedure (how, who, authority needed) used to perform the following activities).

a. Create/delete a
  - department.
  - service.
  - supervisory position.

b. Decide to hire/fire a supervisor.

c. Decide to promote a supervisor.

d. Decide to change the responsibility and authority of a supervisor.

e. Decide on training method of supervisors.

f. Choose equipment (brand, capacity...).

g. Choose a supplier.

h. Set price limits for equipment (i.e. what limit at what level?).

i. How much unallocated/unbudgeted money can be spent at what level without authorization?

4.2 Impact of IT.

a. Where has IT been mostly applied (control or support any particular set of decisions?)

b. How is IT applied: (1) to provide more control to Top managers, to Middle manager; (2) to distribute information to more people? (3) who's interests are served?

c. How did IT affect these decisions (centralization vs decentralization?)

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B: DEPARTMENT

5. STRUCTURE OF THE UNIT.

5.1 Determine the structure of his unit (who reports to whom, how many employees).

5.2 How did IT affect the structure of his unit, especially MM?

a. On the focus of attention (Top managers, middle managers,
Operations managers
b. Number of middle management.
c. Roles of middle managers (interpersonal, informational,
decisional).
d. Range/number of decisions.

6. CONTROL OF COMPUTING DECISIONS (top managers vs middle managers).

6.1 Is there a steering committee? Who are its members?
6.2 Which group, if any, controls computing (top management, middle management, operations management, DP, end users, other).

6.3 What word (formal authority, power, influence) middle managers have to say in computing decisions (general orientation, operational decisions)?

6.4 Political behavior of middle managers (previous successful upward influencers?)

7. COMMUNICATION (vertical and horizontal).

7.1 Description of the pattern of communication: vertical (between top and operations managers), and horizontal (between peers).

7.2 Where has IT been mostly applied?

7.3 How did IT affect the communication pattern (media used E-Mail vs Middle managers)

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7.4 How did IT affect the control of information and communication?

9. AFTERTHOUGHTS AND COMMENTS.

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Interview Guide: Middle Manager

Organization:___________________________ Date:__________

1. INTRODUCTION.

* Purpose and nature of the study.
* Selection of respondents.
* Assure of anonymity.
* May find some questions silly, difficult to answer
* Feel free to interrupt, ask question, clarification.
* My background (origin, training, interests).
* Permission to record
    - permit to focus on interaction,
    - cannot write everything down,
    - easier to reconstitute interview.
* Length of the interview.
* Documentation:
    - Specific description of middle managers' job.

2. RESPONDENT.

Name :______________________________ Phone:____________

Title :___________________________ Since: _______

Job description :____

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Previous position :

Time in organization :

Education :

Other :

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3. INFORMATION ON MIDDLE MANAGERS.

3.1 Roles of middle managers.

a. Description of what he/she does (typically).
b. Allocate one typical week of work by % to each role and sub-role):

. Interpersonal roles
  (1) FIGUREHEAD (Ceremonial nature, representative of your unit for external events, e.g. mayor's reception, tour visitors for other units or cities),
  (2) LEADER (Direct and indirect efforts to motivate subordinate to attain organization's objectives),
  (3) LIAISON (Make contacts outside hierarchical chain of command e.g. peers of other units, departments, organizations).

. Informational roles
  (1) MONITOR (scan environment and other units for information, and also monitor the work of employees below you),
  (2) DISSEMINATOR (information link between you superior and subordinates),
  (3) SPOKESMAN (send information outside your unit e.g. report to people who control your unit, user (for DP), mayor, councilors...).

. Decisional roles
  (1) ENTREPRENEUR (try to change and ameliorate your unit),
  (2) DISTURBANCE HANDLER (resolve conflicts, misunderstandings in and outside your unit),
  (3) RESOURCES ALLOCATOR (decide who gets what, authorize decisions),
  (4) NEGOTIATOR (within and across your unit e.g. budget allocation).

c. Where has IT been applied most?
d. How did IT affect these roles?
e. How did IT affect the range and number of decisions he/she makes?

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4. CONTROL OF COMPUTING DECISIONS (top managers vs middle managers).

4.1 Is there a steering committee? who are its members?

4.2 Which group, if any, controls computing (top management, middle management, operations management, DP, end users, other).

4.3 What word (formal authority, power, influence) middle managers have to say in computing decisions (general orientation, operational decisions)?

4.4 Political behavior of middle managers (previous successful upward influencers?)

5. AFTERTHOUGHTS AND COMMENTS.

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Interview Guide: DP Manager

Organization:____________________________ Date:__________

1. INTRODUCTION.

* Purpose and nature of the study.
* Selection of respondents.
* Assure of anonymity.
* May find some questions silly, difficult to answer
* Feel free to interrupt, ask question, clarification.
* My background (origin, training, interests).
* Permission to record
    - permit to focus on interaction,
    - cannot write everything down,
    - easier to reconstitute interview.
* Length of the interview.
* Documentation:
    - DP budget.
    - Detailed DP organization chart.
    - Organizational documents.

2. RESPONDENT.

Name :______________________________ Phone:____________

Title :___________________________ Since: _______

Job description :____

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Previous position :

Time in organization :

Education :

Other :

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3. CHARACTERISTICS OF COMPUTING ENVIRONMENT.

3.1 What is the general role of DP in the overall organization (present and future)?

3.2 What is the orientation of computing efforts (present and future)?
- (1) increase quality: management operations efficiency,

or
- (2) increase control and decrease cost: decrease management and operations personnel, control expenditure),

3.3 What is the focus of DP (present and future)?
- (1) focus on any particular level (top, middle, opera- tions)?
- (2) focus on any particular functional area?

3.4 Budget ($, allocation).

3.5 Structure of the DP department (number of employees i.e. analysts, designers, programmers ...)

3.6 Equipment (number of mainframe, minis, micros, distribution of them...)

3.7 Back log (time, number of applications), solution?

3.8 Main issues.

4. RECENT EVOLUTION IN THE LAST 5 YEARS (new DP manager; new policy, standards, rules, procedures; new mainframe...).

5. INFORMATION TECHNOLOGY.

5.1 Perceived state of the art.

a. How do new applications/technology emerge i.e. is there
a group responsible for looking outside to find, understand and apply innovations? Is it user driven?...
b. Fully "utilize" available technology (especially with regard to possible applications at middle management level)? If not, why?

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5.2 Degree of automation (*** fill matrix ***).

a. Number of applications in operation.
b. Horizontal automation, across departments (i.e. allocation of automation by % in each department).
c. Vertical automation, across hierarchical levels (i.e. allocation of automation by % in each management level (top, middle, operations).
d. Allocation of automation by % of employees having access to it.

6. CONTROL OF COMPUTING DECISIONS (TOP MANAGERS VS MIDDLE MANAGERS).

6.1 Managerial.

a. How are the plan, objective, and priorities for computing usage and development efforts established?
b. How is the DP budget allocated?
c. Is there an overarching group? (if yes, what is its role, who are the members? what influence does it have?)
d. Which group, if any, controls computing (top management, middle management, operations management, DP, end users, other).
e. What word (formal authority, power, influence) middle managers have to say in computing decisions (general orientation, operational decisions...).
f. Political behavior of middle managers (previous successful upward influencers?)
g. Role of DP managers: (1) carry out directives established by top management, (2) work with top management to establish DP orientation, (3) establish DP orientation and introduce technical innovation.

6.3 Operational.

a. Configuration (any satellite, installation; 1 mainframe vs distributed systems?)

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7. PERCEIVED IMPACT OF IT.

7.1 On middle managers.

a. Number of middle management.
b. Roles of middle managers (interpersonal, informational, decisional).
c. Range/number of decisions.
d. Information used (formal vs informal, verbal vs written..)
e. Processes used (structured vs unstructured...)

7.2 On the degree of centralization of decision making (how is IT applied: (1) to provide more control to Top managers, to Middle manager; (2) to distribute information to more people? (3) who's interests are served?

7.3 On the vertical and horizontal communication patterns (what is used: IT vs MM)(E-Mail ...).

7.4 On the control of information and communications (who controls communications).

8. AFTERTHOUGHTS AND COMMENTS.

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Matrix of IT Applications

	Control	Coordination	Efficiency	Access	Total
General Gov. and Admin. services - Treasury - Assessment - Accounting - Bdgtg mgmt - Purch. & invt. - Personnel - Data proces. - Public bldngs - Clerk/recorder - Central garage - Libraries	appl:	appl:	appl:	term. : pc :	appl : term : pc : emps :
Public Safety - Police - Fire - Courts - Emgcy prep. - Emgncy med.	appl:	appl:	appl:	term. : pc :	appl : term : pc : emps :
Community Srvcs - Public health - Public welfare - Parks and rec.	appl:	appl:	appl:	term. : pc :	appl : term : pc : emps :
Public Works - Licensing - Engineering - Transportation - Water supply - Utilities	appl:	appl:	appl:	term. : pc :	appl : term : pc : emps :
Public Services - Strts and hws - Sanitation	appl:	appl:	appl:	term. : pc :	appl : term : pc : emps :
Community Dev. - Plng & zoning - Housing, & & commu. dev.	appl:	appl:	appl:	term. : pc :	appl : term : pc : emps :
************* Change in the last 5 years *************	Total appl:	Total appl:	Total appl:	Total term. : pc :	Total appl : term : pc : emps :

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Interview Guide: Personnel Director

Organization:______________________________ Date:__________

1. INTRODUCTION.

* Purpose and nature of the study.
* Selection of respondents.
* Assure of anonymity.
* May find some questions silly, difficult to answer
* Feel free to interrupt, ask question, clarification.
* My background (origin, training, interests).
* Permission to record
    - permit to focus on interaction,
    - cannot write everything down,
    - easier to reconstitute interview.
* Length of the interview.
* Documentation:
    - job descriptions of middle managers.
    - Organizational documents

2. RESPONDENT.

Name :________________________________ Phone:____________

Title :______________________________ Since: _______

Job description :____

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Previous position :____________________

Time in organization :____________________

Education :____________________

Other :____________________

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3. CHARACTERISTICS OF THE ORGANIZATION.

a. Total number of employees.
b. Number of top managers.
c. Number of middle managers.
d. Number of operations managers.
e. Number of office employees.
f. Other (describe).

4. PERCEIVED IMPACT OF IT ON MIDDLE MANAGEMENT.

a. Number of middle management.
b. Other aspects of middle management.

5. AFTERTHOUGHTS AND COMMENTS.

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Appendix H

Residual Analysis

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The histogram and the graphic of the cumulative probabilities of the observed residuals against the predicted residuals (p.334-340) indicate that the residuals are normally distributed.

Also, the graph of the predicted residuals of the ratio of middle manager against the observed residuals (p.341) and the graphs of the residuals of each independent variable plotted against the residuals of the dependent variable (p.342-344) show no sign of curvilinearity, important outlier or heteroscedasticity (the error term in a regression has an nonconstant variance). The assumptions of linearity and homogeneity of variance are met. The residuals are all centered around 0 and they have a constant variance.

The graphs also indicate that there might be some important outliers and influential data points biasing the regression analysis. This is further investigated by looking at the standardized residuals, the studentized deleted residuals, the leverage, and the Cook distance (see p.334-338)[1]. The standardized and studentized deleted residuals are measures of the size of the residuals and the leverage and Cook distance are measures of how influential the outlier are. It is important to note that the statistical tests are only indicative of potential exceptional cases that may need to be removed. We decide whether or not the exceptional case identified by statistical tests should be dropped based on theoretical justifications. The standardized and studentized deleted residuals indicate that there are ten unusual cases which can be abnormally influential

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- Bossier City, CA (case #141)
- Buena Park, CA (case #8)
- Corpus Christi, TX (case #109)
- Huntsivlle, AL (case #2)
- Laredo, TX (case #114)
- Lawrence, KS (case #140)
- Newport Beach, CA (case #132)
- Overalnd Park, KS (case #66)
- Stamford, CT (case #144)
- Warwick, RI (case #102))

The leverage and Cook distance scores indicate, however, that there is no influential outlier. Therefore, the analysis of the residuals indicates that the errors are distributed randomly, that the assumptions of linearity and homogeneity of residuals are met, and that there are no abnormally influential outlier.

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13-Dec-89    SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:13     PPRO COMPUTING FACILITY         IBM 9375-60        VM/CMS 5.0

File:      combined midmgmt file for cities ge 50000 in 80

                              * * * *   M U L T I P L E   R E G R E S S I O N   * * * *

Equation Number 1    Dependent Variable..   RATIOMM

Casewise Plot of Standardized Residual

*: Selected    M: Missing

                 -3.0       0.0       3.0
 Case # CITYID    O:.........:.........:O    RATIOMM     *PRED    *RESID   *ZRESID  *SDRESID    *LEVER   *COOK D
      1      1    .         .*        .         .95     .9017     .0500     .3055     .3294     .1387     .0017
      2      3    *         .         .         .04     .7995    -.7578   -4.6287   -5.1041     .0270     .0699
      3      8    .         .*        .         .90     .8420     .0566     .3455     .3588     .0717     .0010
      4     10    .         *         .         .79     .8039    -.0102    -.0624    -.0646     .0666     .0000
      5     11    .         .  *      .         .93     .7779     .1540     .9404     .9575     .0294     .0031
      6     16    .         . *       .         .81     .6762     .1306     .7976     .8119     .0308     .0023
      7     19    .         . *       .         .83     .7263     .1013     .6185     .6324     .0412     .0018
      8     22    . *       .         .         .25     .6707    -.4255   -2.5988   -2.7404     .0532     .0415
      9     23    .         . *       .         .89     .7525     .1364     .8329     .8599     .0570     .0046
     10     25    .         *         .         .76     .7446     .0126     .0767     .0775     .0196     .0000
     11     27    .        *.         .         .75     .8336    -.0792    -.4840    -.5318     .1693     .0055
     12     29    .         .  *      .         .80     .6286     .1714    1.0469    1.0857     .0626     .0079
     13     34    .         .*        .         .88     .7945     .0805     .4917     .4972     .0207     .0006
     14     35    .         . *       .         .81     .7137     .0971     .5929     .5984     .0164     .0008
     15     36    .         .  *      .         .94     .7453     .1899    1.1598    1.1966     .0512     .0079
     16     37    .         .   *     .         .91     .7145     .1917    1.1712    1.1811     .0076     .0018
     17     39    .         . *       .         .82     .6950     .1211     .7394     .7509     .0268     .0018
     18     40    .         . *       .         .86     .7681     .0924     .5643     .5802     .0518     .0019
     19     41    .        *.         .         .80     .8237    -.0282    -.1723    -.1818     .1013     .0004
     20     43    .         . *       .         .94     .8177     .1257     .7677     .7976     .0694     .0048
     21     44    .        *.         .         .94     .9962    -.0567    -.3466    -.3662     .1028     .0015
     22     46    .         *         .         .67     .6525     .0210     .1280     .1333     .0775     .0001
     23     48    .         .*        .         .85     .7981     .0567     .3461     .3576     .0626     .0009
     24     49    .         .*        .         .74     .6846     .0546     .3333     .3417     .0480     .0006
     25     50    .         .  *      .         .76     .6079     .1502     .9174     .9517     .0649     .0063
     26     53    .         . *       .         .82     .7198     .1002     .6118     .6331     .0634     .0027
     27     55    .         .*        .         .87     .8181     .0547     .3339     .3896     .2634     .0051
     28     61    .         . *       .         .86     .7496     .1150     .7023     .8264     .2729     .0241
     29     62    .         . *       .         .83     .7262     .0998     .6099     .6235     .0408     .0018
     30     64    .        *.         .         .93     .9627    -.0339    -.2069    -.2210     .1235     .0007
     31     65    .         .*        .         .93     .8603     .0675     .4124     .4180     .0255     .0005
     32     68    .         . *       .         .90     .8016     .1007     .6148     .6596     .1282     .0062
     33     70    .         .  *      .         .86     .7152     .1459     .8910     .9079     .0315     .0030
     34     72    .         . *       .         .83     .7070     .1242     .7586     .7667     .0173     .0013
     35     77    .         . *       .         .83     .7376     .0957     .5846     .5914     .0210     .0009
     36     78    .        *.         .         .64     .6970    -.0581    -.3548    -.3571     .0123     .0002
     37     81    .        *.         .         .69     .7668    -.0745    -.4548    -.4879     .1292     .0034
     38     82    .         .  *      .         .87     .6842     .1824    1.1142    1.1332     .0247     .0038
     39     84    .         .  *      .         .92     .7626     .1555     .9498     .9870     .0677     .0071
 Case # CITYID    O:.........:.........:O    RATIOMM     *PRED    *RESID   *ZRESID  *SDRESID    *LEVER   *COOK D
                 -3.0       0.0       3.0
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13-Dec-89    SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:15     PPRO COMPUTING FACILITY         IBM 9375-60        VM/CMS 5.0

File:      combined midmgmt file for cities ge 50000 in 80

Casewise Plot of Standardized Residual

*: Selected    M: Missing

                  -3.0      0.0      3.0
Case # CITYID      O:.........:.........:O    RATIOMM     *PRED      *RESID    *ZRESID   *SDRESID     *LEVER    *COOK D
    40     86       .      *  .         .         .70     .8492      -.1522     -.9297     -.9507      .0378      .0038
    41     93       .      *  .         .         .59     .7289      -.1371     -.8373     -.8443      .0121      .0012
    42     95       .         . *       .         .86     .7638       .0934      .5702      .5879      .0572      .0021
    43     96       .         .*        .         .71     .6800       .0343      .2093      .2125      .0301      .0002
    44    101       *         .         .         .00     .7446      -.7446    -4.5483    -5.0260      .0356      .0863
    45    102       .         .*        .         .79     .7319       .0576      .3517      .3884      .1784      .0031
    46    112       .         *         .         .77     .7547       .0158      .0964      .1025      .1154      .0001
    47    114       .         .*        .         .86     .7818       .0753      .4601      .4778      .0713      .0018
    48    116       .         . *       .         .93     .8058       .1223      .7472      .7582      .0252      .0017
    49    118       .        *.         .         .76     .8230      -.0637     -.3892     -.3976      .0410      .0007
    50    119       .         *         .         .86     .8607 -2.6620E-03     -.0163     -.0167      .0570      .0000
    51    121       .         . *       .         .80     .6843       .1108      .6770      .7264      .1278      .0075
    52    123       .         .  *      .         .96     .7889       .1670     1.0200     1.0678      .0802      .0098
    53    127       .         . *       .         .94     .8016       .1354      .8268      .8337      .0120      .0012
    54    128       .         *         .         .86     .8699 -6.4086E-03     -.0391     -.0404      .0591      .0000
    55    129       .      *  .         .         .50     .6774      -.1774    -1.0836    -1.1045      .0295      .0041
    56    136       .         . *       .         .83     .6933       .1321      .8068      .8353      .0625      .0047
    57    139       .         *         .         .66     .6834      -.0255     -.1559     -.1582      .0290      .0001
    58    142       .        *.         .         .64     .6738      -.0374     -.2285     -.2316      .0273      .0002
    59    144       .       * .         .         .60     .7289      -.1331     -.8132     -.8236      .0208      .0017
    60    145       .         . *       .         .92     .7955       .1196      .7304      .7914      .1441      .0101
    61    152       .         .  *      .         .94     .7815       .1564      .9555      .9873      .0570      .0060
    62    157       .         .*        .         .74     .7062       .0319      .1946      .1992      .0456      .0002
    63    159       .       * .         .         .61     .7169      -.1037     -.6331     -.6525      .0557      .0026
    64    162       .         . *       .         .88     .7546       .1291      .7884      .8038      .0336      .0025
    65    166       .         .*        .         .88     .7959       .0791      .4832      .5066      .0884      .0025
    66    167       .   *     .         .         .39     .6894      -.3036    -1.8547    -2.1896      .2570      .1519
    67    171       .         .   *     .         .96     .7341       .2252     1.3758     1.3993      .0204      .0049
    68    173       .     *   .         .         .53     .7549      -.2216    -1.3535    -1.3845      .0317      .0069
    69    176       .         *         .         .73     .7356 -8.3393E-03     -.0509     -.0515      .0237      .0000
    70    198       .       * .         .         .64     .7454      -.1090     -.6659     -.6818      .0432      .0022
    71    210       .        *.         .         .69     .7609      -.0665     -.4060     -.4198      .0635      .0012
    72    211       .         .*        .         .80     .7600       .0354      .2163      .2215      .0461      .0002
    73    221       .       * .         .         .60     .6974      -.0937     -.5722     -.5765      .0130      .0006
    74    227       .         . *       .         .81     .7014       .1062      .6489      .6528      .0092      .0006
    75    230       .         . *       .         .80     .7160       .0863      .5273      .5307      .0116      .0005
    76    232       .         .   *     .         .96     .7582       .1968     1.2024     1.2424      .0534      .0089
    77    236       .         .*        .         .93     .8617       .0678      .4140      .4199      .0270      .0006
    78    238       .         .*        .         .86     .7989       .0626      .3824      .3860      .0179      .0003
    79    239       .         . *       .         .79     .6948       .0930      .5683      .5789      .0343      .0013
    80    240       .         . *       .         .89     .7740       .1199      .7324      .7631      .0751      .0047
    81    241       .         .*        .         .86     .8074       .0562      .3433      .3467      .0189      .0003
    82    242       .         .   *     .         .94     .7310       .2092     1.2781     1.3123      .0401      .0076
Case # CITYID      O:.........:.........:O    RATIOMM     *PRED      *RESID    *ZRESID   *SDRESID     *LEVER    *COOK D
                  -3.0      0.0      3.0
```

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```
13-Dec-89    SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:18     PPRO COMPUTING FACILITY        IBM 9375-60      VM/CMS 5.0

File:      combined midmgmt file for cities ge 50000 in 80


Casewise Plot of Standardized Residual

*: Selected    M: Missing

                   -3.0     0.0      3.0
Case # CITYID      0:........:........:0   RATIOMM     *PRED       *RESID    *ZRESID   *SDRESID     *LEVER    *COOK D
    83    244       .        *        .        .77     .7626   6.6030E-03     .0403      .0407      .0182      .0000
    84    245       .       *.        .        .64     .7000       -.0579    -.3534     -.3795      .1315      .0021
    85    254       .        . *      .        .92     .8300        .0926     .5655      .5836      .0591      .0022
    86    271       .        .*       .        .83     .7843        .0490     .2994      .3035      .0264      .0003
    87    277       .        .  *     .        .96     .7907        .1646    1.0054     1.0833      .1311      .0170
    88    278       .        .*       .        .85     .7775        .0704     .4302      .4393      .0399      .0009
    89    279       .        . *      .        .83     .7256        .1077     .6580      .6666      .0231      .0012
    90    281       .        *        .        .76     .7435        .0140     .0858      .0864      .0136      .0000
    91    282       .        *        .        .77     .7929       -.0187    -.1145     -.1202      .0924      .0001
    92    286       .        .*       .        .84     .7805        .0632     .3862      .3915      .0260      .0005
    93    287       .      * .        .        .61     .7353       -.1212    -.7404     -.7712      .0744      .0048
    94    290       .     *  .        .        .52     .7194       -.2033   -1.2415    -1.2659      .0277      .0051
    95    295       .        . *      .        .74     .6435        .0956     .5841      .6004      .0515      .0020
    96    300       .        .*       .        .72     .6713        .0509     .3109      .3149      .0251      .0003
    97    306       .        .  *     .        .90     .7333        .1711    1.0454     1.0572      .0149      .0022
    98    307       .        .*       .        .76     .7073        .0554     .3385      .3428      .0245      .0003
    99    318       .       *.        .        .59     .6523       -.0641    -.3915     -.3997      .0399      .0007
   100    320       .        .*       .        .97     .8909        .0811     .4955      .5268      .1133      .0035
   101    323       .       *.        .        .50     .5798       -.0798    -.4871     -.5156      .1054      .0031
   102    329       .        .    *   .        .89     .6038        .2832    1.7296     2.0071      .2352      .1143
   103    331       .        . *      .        .89     .7819        .1124     .6864      .6974      .0283      .0016
   104    333       .        .*       .        .83     .7684        .0568     .3470      .3526      .0310      .0004
   105    335       .       *.        .        .78     .8347       -.0509    -.3111     -.3175      .0398      .0004
   106    339       .        .*       .        .84     .7919        .0476     .2909      .2948      .0259      .0003
   107    340       .        *        .        .85     .8251        .0211     .1286      .1311      .0379      .0001
   108    341       .        .*       .        .97     .8895        .0791     .4830      .5015      .0707      .0019
   109    344       .   *    .        .        .41     .7478       -.3331   -2.0349    -2.0796      .0137      .0079
   110    345       .      * .        .        .83     .9172       -.0864    -.5276     -.5429      .0539      .0017
   111    348       .        .*       .        .85     .8045        .0430     .2626      .2716      .0647      .0005
   112    349       .      * .        .        .68     .7702       -.0860    -.5255     -.5361      .0374      .0012
   113    352       .        .*       .        .77     .7246        .0474     .2898      .2920      .0147      .0002
   114    353       .  *     .        .        .27     .6666       -.3963   -2.4207    -2.5078      .0273      .0193
   115    355       .        .  *     .        .85     .6686        .1802    1.1006     1.1257      .0357      .0051
   116    359       .        *        .        .81     .8092  -2.7466E-03    -.0168     -.0178      .1065      .0000
   117    360       .     *  .        .        .64     .7896       -.1455    -.8890     -.9258      .0723      .0067
   118    362       .     *  .        .        .62     .7589       -.1399    -.8545     -.8755      .0425      .0036
   119    363       .      * .        .        .67     .7541       -.0874    -.5341     -.5405      .0218      .0008
   120    368       .     *  .        .        .64     .7816       -.1462    -.8931     -.9508      .1118      .0110
   121    372       .    *   .        .        .51     .7652       -.2577   -1.5740    -1.6525      .0752      .0218
   122    374       .       *.        .        .73     .7797       -.0468    -.2858     -.2954      .0630      .0006
   123    378       .       *.        .        .75     .7809       -.0309    -.1888     -.1910      .0231      .0001
   124    381       .       *.        .        .70     .7605       -.0568    -.3469     -.3623      .0825      .0012
   125    382       .        *        .        .90     .8936   7.4185E-03     .0453      .0486      .1315      .0000
Case # CITYID      0:........:........:0   RATIOMM     *PRED       *RESID    *ZRESID   *SDRESID     *LEVER    *COOK D
                   -3.0     0.0      3.0
```


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```
13-Dec-89    SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:21     PPRO COMPUTING FACILITY          IBM 9375-60        VM/CMS 5.0

File:      combined midmgmt file for cities ge 50000 in 80

Casewise Plot of Standardized Residual

*: Selected    M: Missing

                 -3.0      0.0      3.0
Case # CITYID     O:........:........:O   RATIOMM      *PRED      *RESID    *ZRESID   *SDRESID     *LEVER    *COOK D
   126    387     .         . *       .       .81      .7137       .0919      .5611      .5660      .0153      .0007
   127    393     .       * .         .       .69      .8201      -.1338     -.8174     -.9773      .2942      .0373
   128    394     .       * .         .       .64      .7462      -.1099     -.6710     -.7104      .1044      .0057
   129    408     .         *         .       .86      .8531  9.0142E-03      .0551      .0621      .2140      .0001
   130    410     .         .  *      .       .93      .7755       .1556      .9502      .9773      .0485      .0051
   131    413     .         *         .       .76      .7719      -.0110     -.0672     -.0709      .1013      .0001
   132    416     .    *    .         .       .40      .6689      -.2689    -1.6425    -1.6680      .0117      .0046
   133    417     .         .   *     .       .85      .6560       .1928     1.1774     1.1952      .0201      .0035
   134    418     .         .*        .       .68      .6257       .0517      .3160      .3268      .0642      .0007
   135    420     .         .  *      .       .81      .6539       .1526      .9319      .9450      .0218      .0024
   136    425     .         *         .       .77      .7617  6.1239E-03      .0374      .0390      .0779      .0000
   137    426     .         *         .       .68      .7087      -.0269     -.1645     -.1679      .0397      .0001
   138    429     .      *  .         .       .51      .6660      -.1549     -.9459     -.9573      .0179      .0021
   139    430     .         .*        .       .78      .7298       .0463      .2829      .2876      .0321      .0003
   140    431     .    *    .         .       .46      .7332      -.2749    -1.6792    -1.7798      .0899      .0303
   141    433     . *       .         .       .29      .6999      -.4141    -2.5297    -2.6440      .0398      .0296
   142    435     .         .*        .       .73      .6555       .0762      .4657      .4934      .1071      .0029
   143    436     .         *         .       .65      .6277       .0174      .1066      .1134      .1161      .0002
   144    437     .    *    .         .       .47      .7353      -.2647    -1.6169    -1.6799      .0553      .0167
   145    438     .       * .         .       .64      .7233      -.0823     -.5026     -.5778      .2405      .0100
   146    443     .      *  .         .       .50      .6383      -.1383     -.8449     -.8808      .0748      .0063
   147    445     .     *   .         .       .48      .7077      -.2233    -1.3640    -1.7106      .3491      .1449
   148    446     .         *         .       .71      .6917       .0225      .1377      .1387      .0158      .0000
   149    447     .     *   .         .       .44      .6474      -.2055    -1.2552    -1.2822      .0310      .0058
   150    448     .       * .         .       .66      .7919      -.1340     -.8185     -.8909      .1507      .0135
   151    450     .         . *       .       .78      .6949       .0895      .5465      .5551      .0289      .0010
   152    453     .        *.         .       .65      .7262      -.0770     -.4705     -.4748      .0166      .0005
   153    454     .         *         .       .68      .6552       .0248      .1516      .1593      .0946      .0003
   154    460     .         .*        .       .71      .6593       .0512      .3127      .3181      .0331      .0004
Case # CITYID     O:........:........:O   RATIOMM      *PRED      *RESID    *ZRESID   *SDRESID     *LEVER    *COOK D
                 -3.0      0.0      3.0
```


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File: combined midmgmt file for cities ge 50000 in 80

**** MULTIPLE REGRESSION ****

Equation Number 1 Dependent Variable.. RATIOMM

Residuals Statistics:

	Min	Max	Mean	Std Dev	N
*PRED	.5798	.9962	.7487	.0703	154
*ZPRED	-2.4036	3.5209	.0000	1.0000	154
*SEPRED	.0194	.0976	.0409	.0156	154
*ADJPRED	.5136	1.0032	.7496	.0730	154
*RESID	-.7578	.2832	.0000	.1583	154
*ZRESID	-4.6287	1.7296	.0000	.9668	154
*SRESID	-4.7083	1.9861	-.0024	1.0020	154
*DRESID	-.7841	.3734	-.0009	.1707	154
*SDRESID	-5.1041	2.0071	-.0092	1.0304	154
*MAHAL	1.1579	53.4150	9.9351	9.2359	154
*COOK D	.0000	.1519	.0075	.0213	154
*LEVER	.0076	.3491	.0649	.0604	154

Total Cases = 154

Durbin-Watson Test = 1.96724

* *

Outliers - Standardized Residual

Case #	CITYID	*ZRESID
2	3	-4.62866
44	101	-4.54830
8	22	-2.59881
141	433	-2.52966
114	353	-2.42070
109	344	-2.03493
66	167	-1.85469
102	329	1.72959
140	431	-1.67921
132	416	-1.64252

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```
13-Dec-89   SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:23    PPRO COMPUTING FACILITY        IBM 9375-60      VM/CMS 5.0

File:       combined midmgmt file for cities ge 50000 in 80

Histogram - Standardized Residual
 N Exp N       (# = 1 Cases,     . : = Normal Curve)
 0   .17   Out
 0   .09  3.00
 0   .12  2.88
 0   .18  2.75
 0   .25  2.63
 0   .34  2.50
 0   .46  2.38
 0   .61  2.25 .
 0   .80  2.13 .
 0  1.04  2.00 .
 0  1.33  1.88 .
 1  1.66  1.75 #.
 0  2.05  1.63  .
 0  2.50  1.50  .
 1  2.99  1.38 # .
 2  3.52  1.25 ## .
 5  4.08  1.13 ###:#
 8  4.66  1.00 ####:###
 5  5.24   .88 ####:
10  5.80   .75 #####:####
15  6.31   .63 #####:#########
 9  6.77   .50 ######:##
15  7.15   .38 ######:########
10  7.44   .25 ######:###
 8  7.61   .13 #######:
 9  7.67   .00 #######:#
 5  7.61  -.13 #####  .
 5  7.44  -.25 ##### .
 7  7.15  -.38 ######:
 8  6.77  -.50 ######:#
 4  6.31  -.63 #### .
 1  5.80  -.75 #    .
 9  5.24  -.88 ####:####
 1  4.66 -1.00 #    .
 1  4.08 -1.13 #   .
 2  3.52 -1.25 ##  .
 2  2.99 -1.38 ##.
 0  2.50 -1.50   .
 4  2.05 -1.63 #:##
 0  1.66 -1.75   .
 1  1.33 -1.88 :
 1  1.04 -2.00 :
 0   .80 -2.13 .
 0   .61 -2.25 .
 1   .46 -2.38 #
 1   .34 -2.50 #
 1   .25 -2.63 #
 0   .18 -2.75
 0   .12 -2.88
 0   .09 -3.00
 2   .17   Out ##
```

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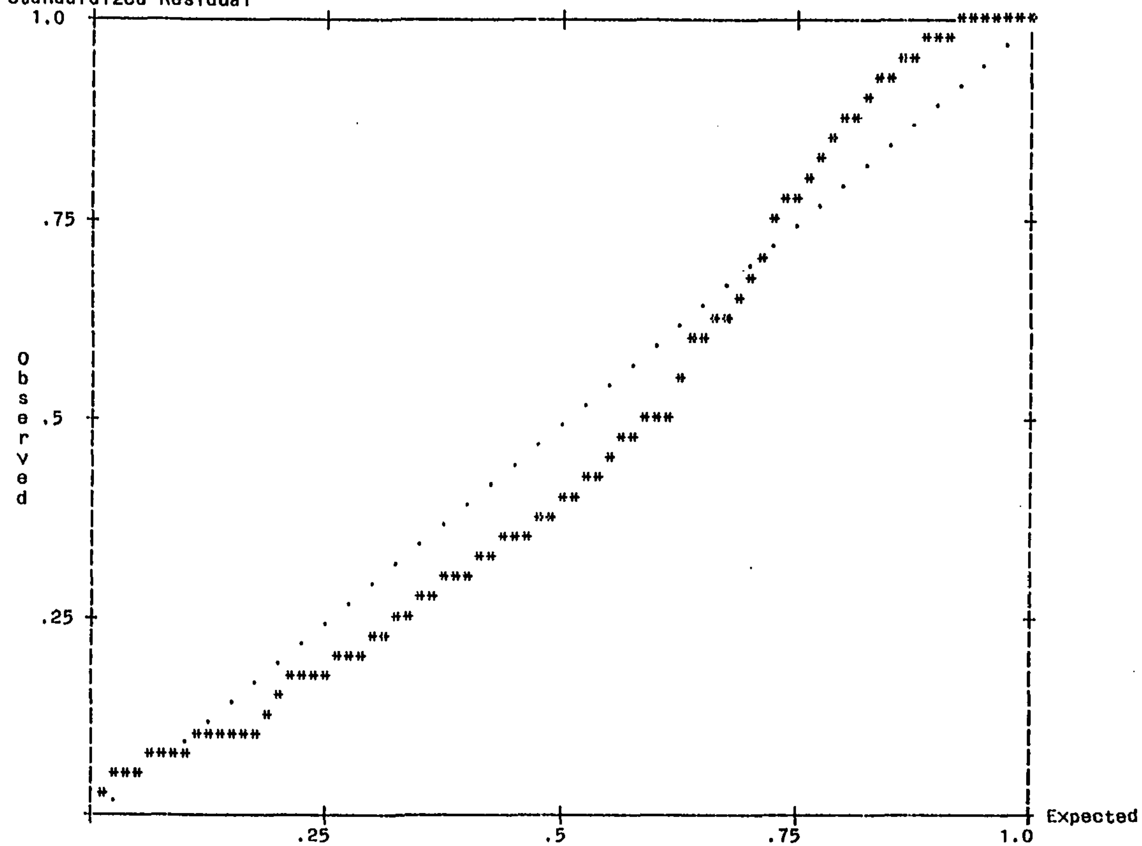
13-Dec-89 SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:23 PPRO COMPUTING FACILITY IBM 9375-60 VM/CMS 5.0

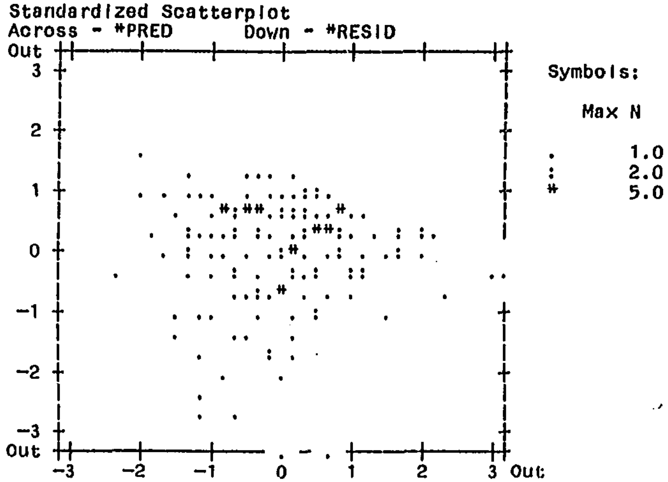
File: combined midmgmt file for cities ge 50000 in 80

Normal Probability (P-P) Plot
Standardized Residual



```
13-Dec-89   SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:23    PPRO COMPUTING FACILITY        IBM 9375-60       VM/CMS 5.0

File:      combined midmgmt file for cities ge 50000 in 80
```



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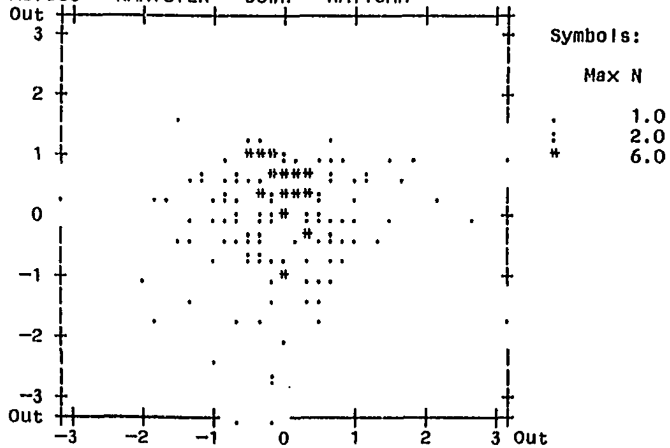
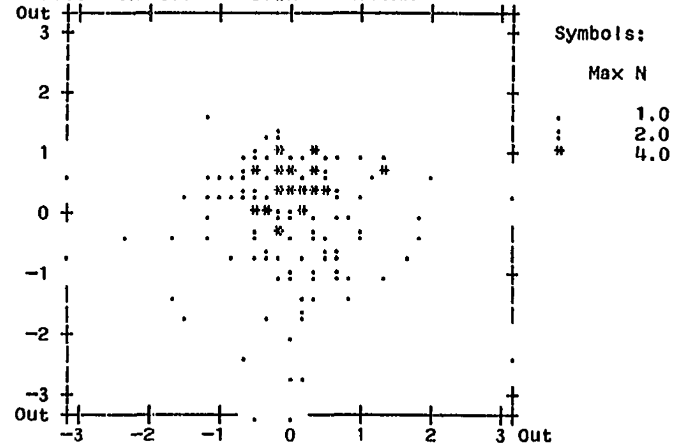
13-Dec-89 SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:23 PPRO COMPUTING FACILITY IBM 9375-60 VM/CMS 5.0

File: combined midmgmt file for cities ge 50000 in 80

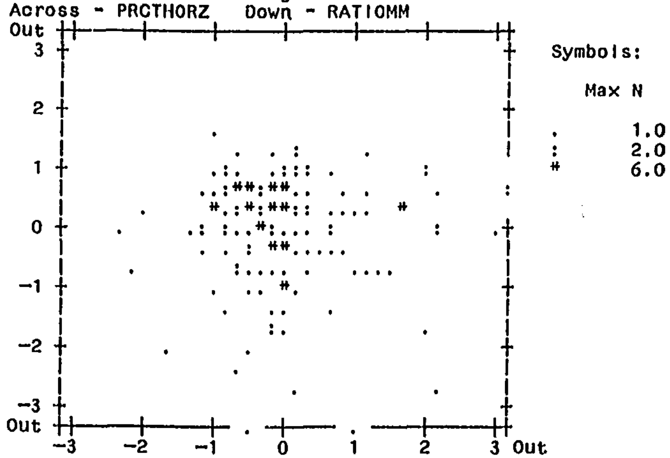
Standardized Partial Regression Plot
Across - RAMICTER Down - RATIOMM



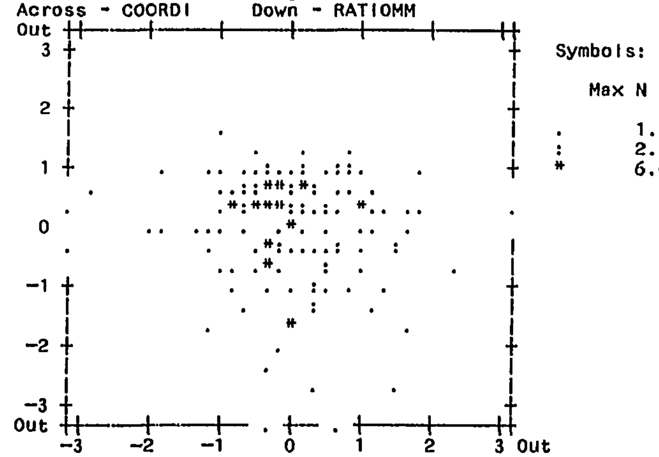
Standardized Partial Regression Plot
Across - ACCESS Down - RATIOMM



Standardized Partial Regression Plot
Across - PRCTHORZ Down - RATIOMM



Standardized Partial Regression Plot
Across - COORDI Down - RATIOMM



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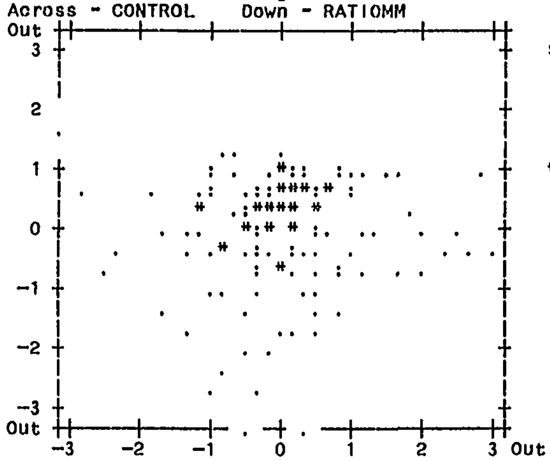
13-Dec-89 SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:24 PPRO COMPUTING FACILITY IBM 9375-60 VM/CMS 5.0

File: combined midmgmt file for cities ge 50000 in 80

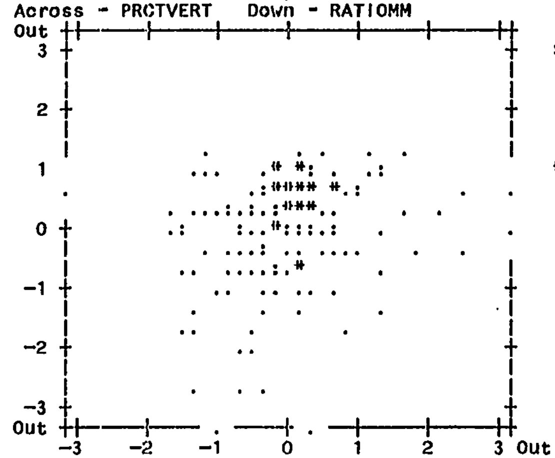
Standardized Partial Regression Plot
Across - CONTROL Down - RATIOMM



Symbols:

Max N	
.	1.0
:	2.0
*	5.0

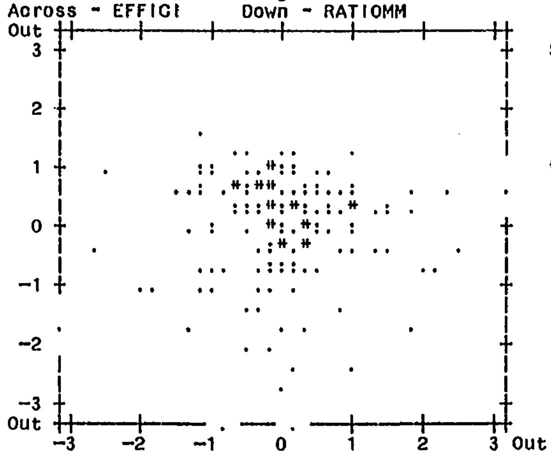
Standardized Partial Regression Plot
Across - PRCTVERT Down - RATIOMM



Symbols:

Max N	
.	1.0
:	2.0
*	6.0

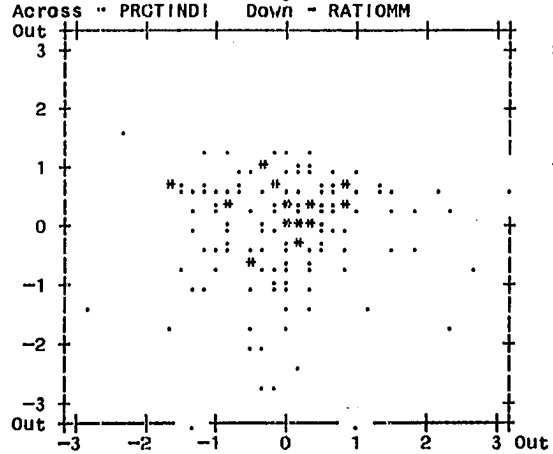
Standardized Partial Regression Plot
Across - EFFICI Down - RATIOMM



Symbols:

Max N	
.	1.0
:	2.0
*	5.0

Standardized Partial Regression Plot
Across - PRCTINDI Down - RATIOMM



Symbols:

Max N	
.	1.0
:	2.0
*	5.0

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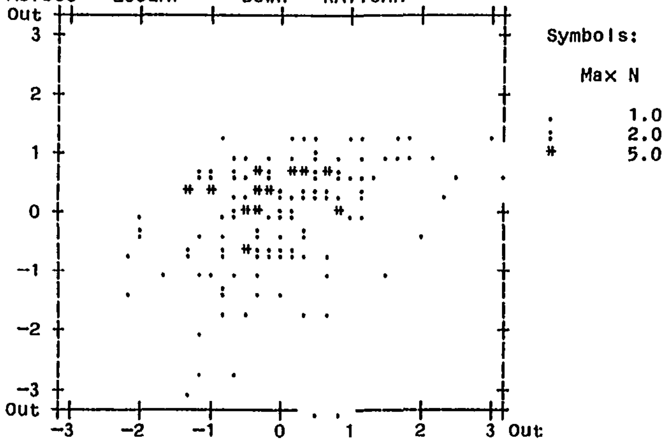
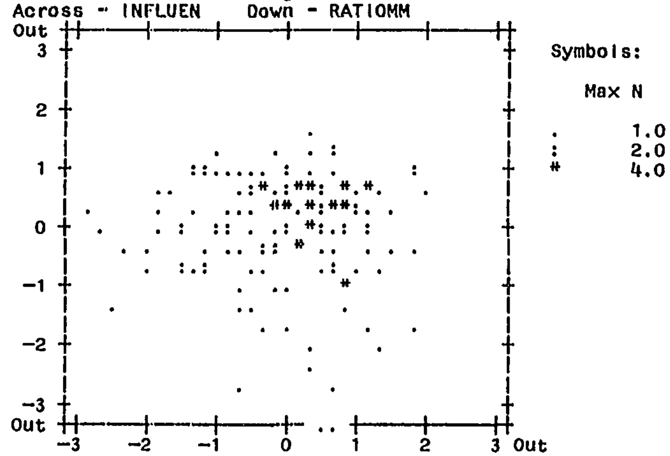
```
13-Dec-89    SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:24     PPRO COMPUTING FACILITY        IBM 9375-60      VM/CMS 5.0

File:     combined midmgmt file for cities ge 50000 in 80
```

Standardized Partial Regression Plot
Across - LOGEMP   Down - RATIOMM



Standardized Partial Regression Plot
Across - INFLUEN   Down - RATIOMM



* *

From Equation 1: 2 new variables have been created.

Name	Contents
PRED1	Predicted Value
RESID1	Residual

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```
13-Dec-89    SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:24     PPRO COMPUTING FACILITY         IBM 9375-60      VM/CMS 5.0

Preceding task required 12.15 seconds CPU time;  21.41 seconds elapsed.

  34  0  plot title = 'residual against ratiomm'/
  35  0       vertical = 'residual'/
  36  0       horizontal = 'ratio of middle level managers'/
  37  0       plot = pred1 with ratiomm; resid1 with ratiomm/

There are 455,392 bytes of memory available.
The largest contiguous area has 454,920 bytes.

PLOT requires 30992 bytes of workspace for execution.
```

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13-Dec-89 SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:29 PPRO COMPUTING FACILITY IBM 9375-60 VM/CMS 5.0

File: combined midmgmt file for cities ge 50000 in 80

* P L O T *

Data Information

154 unweighted cases accepted.

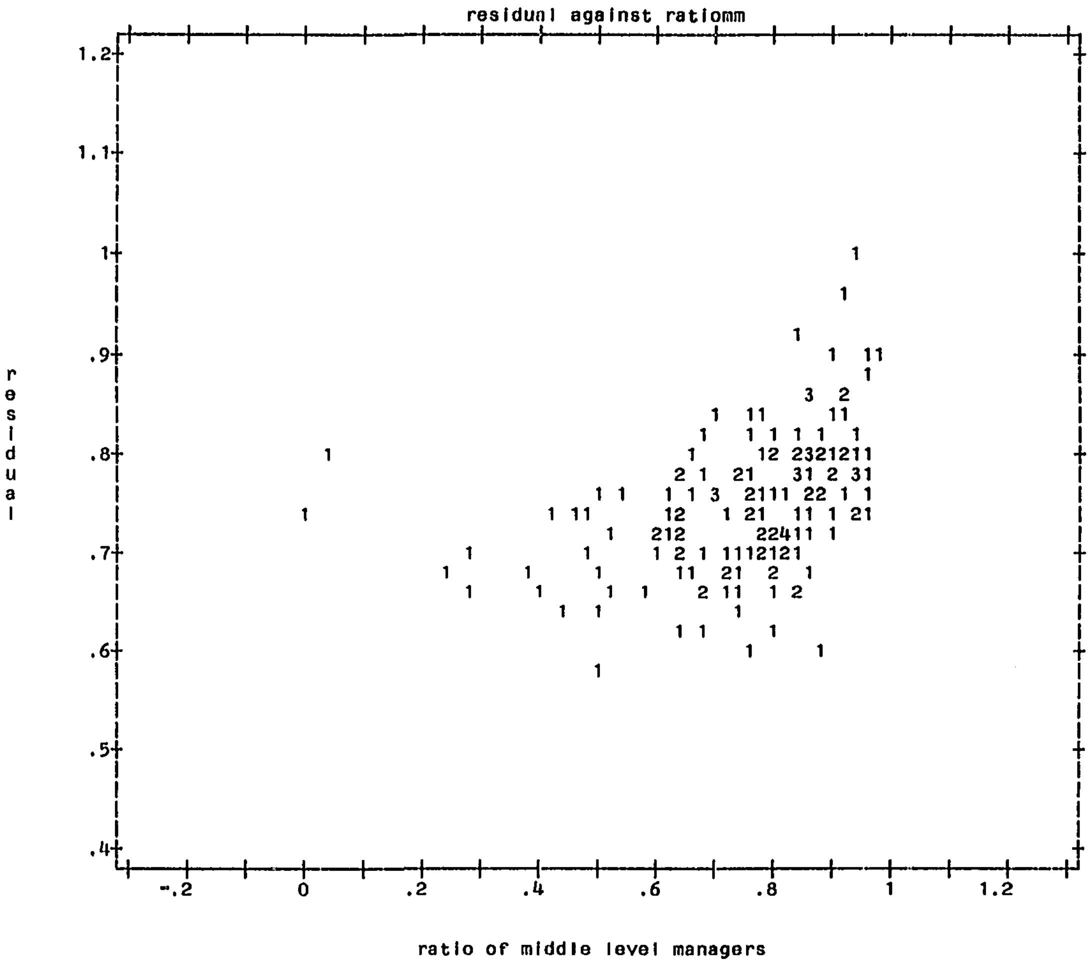
Size of the plots

Horizontal size is 80
Vertical size is 40

Frequencies and symbols used (not applicable for control or overlay plots)

1 - 1	11 - B	21 - L	31 - V
2 - 2	12 - C	22 - M	32 - W
3 - 3	13 - D	23 - N	33 - X
4 - 4	14 - E	24 - O	34 - Y
5 - 5	15 - F	25 - P	35 - Z
6 - 6	16 - G	26 - Q	36 - *
7 - 7	17 - H	27 - R	
8 - 8	18 - I	28 - S	
9 - 9	19 - J	29 - T	
10 - A	20 - K	30 - U	

13-Dec-89 SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:29 PPRO COMPUTING FACILITY IBM 9375-60 VM/CMS 5.0



154 cases plotted.

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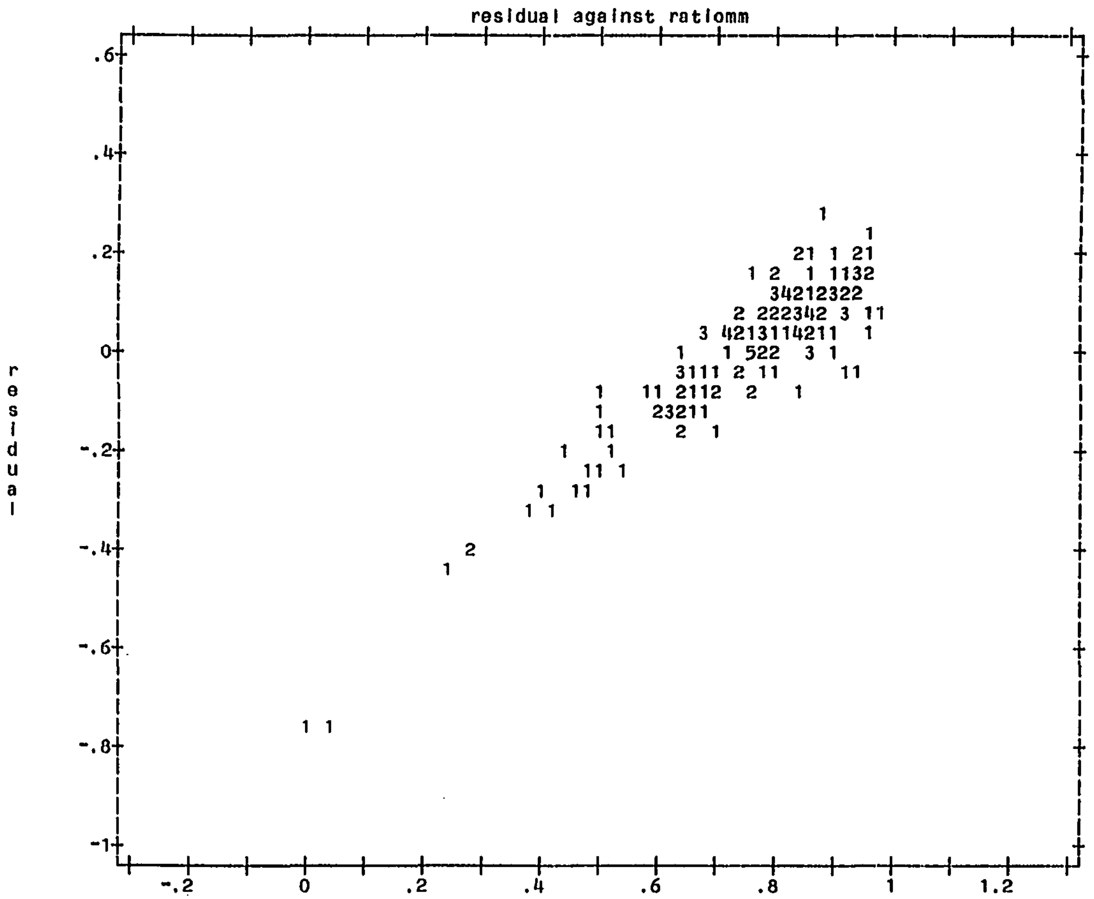
13-Dec-89 SPSS-X RELEASE 3.1 FOR IBM VM/CMS
11:34:30 PPRO COMPUTING FACILITY IBM 9375-60 VM/CMS 5.0



ratio of middle level managers

154 cases plotted.

Endnotes

1. The *Standardized residuals* is the residual divided by its standard error. As with other standardized scores, unusual residual is defined as larger than 2 or -2. The *Studentized deleted residual* score indicates the effect deleting a particular case would have on the regression line. The smaller the number, the smaller the effect. Unusual studentized deleted residuals are greater 2. The *Leverage* indicates the importance and how influential a case is in determining the regression line. The smaller the leverage score, the less influential is the case. Dividing 1 by the leverage score, we obtain an indication of the number of cases that determine the regression line. Unusual score is where the leverage score is larger than .3. For example a leverage score of .01 is small and indicates that 1/.01 = 100 cases determine the regression line. However a score of .3 is large as it indicates that only 1/.3 = 3 cases determine the regression line. Finally the *Cook distance* is an indication of how far away the particular data point is from the regression line. Unusual score is defined as larger than 1.

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