icma yearbook, 7-27-93

COMPUTERS IN LOCAL GOVERNMENT, 1993

Kenneth L. Kraemer and Donald F. Norris

OUTLINE

COMPUTERS IN LOCAL GOVERNMENT, 1993

Kenneth L. Kraemer and Donald F. Norris[1]

INTRODUCTION

Computers continue to play a significant role in the management and operations of local governments. And that role is likely to grow into the next century as city governments become more advanced in their internal use of the technology and extend it outward. Innovative new applications of computers are expected to change the focus of computerization in city and county halls. Rather than focused primarily on internal administration, newer applications are expected to extend the technology outward to the interface between government and citizens and even to direct service delivery to citizens in their homes, offices, and schools. Examples of such applications include computer-based 24-hour city halls, public access to government databanks, public conferencing and communication networks, information kiosks, electronic bill paying, and smart cards for social services payments. During the next decade, cities also will become interconnected with other units and levels of government, and with business, education and health institutions through the National Information Highways being planned by the U.S. government and major telecommunications companies. These are some of the visions for computing in cities. But what is the current reality? And to what extent does it constitute a computing revolution or a continual evolution?

This chapter attempts to answer that question by looking at cities in 1993 and their plans to 1995, and comparing these with selected features from the past. It uses data from ICMAs 1993 Survey of Computer Technology in Local Government. The last major surveys of computing in cities were conducted in 1985--one by ICMA (Scoggins, Tidrick and Auerback, 1985) and another by the Center for Research on Information Technology and Organizations at the University of California, Irvine (Kraemer, King, Dunkle and Lane, 1986). This current survey occurs eight years later, but actually spans a decade through questions about plans for computer use over the next two years. The survey and this chapter cover seven major topics listed below and discussed next:

Computer use and organization

[1]**About the Authors**

Kenneth L. Kraemer is Professor in the Graduate School of Management and Director of the Center for Research on Information Technology and Organizations, both at the University of California, Irvine.

Donald F. Norris is Professor of Public Policy and Director of the Center for Policy Research at the University of Maryland, Baltimore.

Computing resources
Computing expenses
Computer applications
Management policy for computing
Computer use and impact
Future directions for technology

Research Highlights

The 1993 survey reveals interesting and significant features about computing in cities:

Computer Use and Organization

- Population size continues to be a key factor differentiating the use of computing in cities.

- The proportion of cities using computers continues to grow, reaching now to 93% of even the smallest cities--those under 10,000 in population.

- Nearly all cities (95%) continue to obtain computing services through in-house computing departments rather than through outsourcing or shared arrangements with other governments.

- Two-thirds of the cities have a single in-house computing department, but one-third of the cities, usually the larger ones, have multiple departments.

Type of Computer Systems Used

- There is a shift occuring in the type of computer systems being used in cities. Basically the shift is towards greater and greater use of microcomputers and local area networks among all cities regardless of size.

- 92% of all cities use microcomputers, and 75% of these are IBM-PCs or compatibles. The overall average is 40 microcomputers per city, but the average varies greatly by city size. The ratio of micros to municipal employees is 1:93 for large cities, 1:19 for medium-size cities, and 1:3 for small cities. The ratio for services firms in industry is 1:1.

- For the most part, mainframes/minicomputers are not They are being retained for the "legacy" systems that require them, for database servers, and for communications hubs. As might be expected, the large cities use more mainframes/minicomputers than the smallcities. About 90% or more of the large cities use mainframes and/or minicomputers, whereas 74% of the medium-size cities do so, and 45% of the small cities do.

- About one half (48%) of the cities have local area networks (LANs) connecting at least some of their microcomputers with one another. More of the larger cities have LANs than do the smaller ones, and the larger cities have more LANs by a ratio of 10 to 1, though the overall average for cities is 3 LANs.

- Nearly two-thirds of the microcomputers in cities are connected to LANs, and to mainframes and minicomputers.

Computing Expenditures

- Cities spend about 4% of their total operating budgets on computing, which is similar to what counties spend, and about one-half of what services firms spend in industry.

- The proportion of computing budgets spent on personnel in cities (51%) is similar to that spent by counties (53%), but considerably higher than that spent by services firms in industry (43). As a result, the labor-capital ratios for both cities and counties are higher than in services firms, suggesting that the efficiency of the computing function in some local governments might need improvement.

- Spending for computing is less than $1.00 per municipal employee compared to $10,000 per employee in the services industry.

Computer Applications

- Cities tend to use their mainframes, minicomputers and microcomputers for similar tasks. However, microcomputers are used more often for word processing, graphics, spreadsheets, and desk-top publishing.

- Cities use their mainframes, minicomputers and microcomputers in all the government functions, with more cities using them for traditional functions such as public utilities, personnel, administration/office support, law enforcement, and public works. Microcomputers tend to be used more in certain functions historically left out by the larger systems--planning and community development, engineering, fire, parks and recreation, and libraries.

Management Policy

- Although many people are involved in decisions about computer acquisition, three actors are identified by more cities than any others: city manager/CAO, department heads, and MIS/DP director. Some of these actors tend to be more important in particular size cities.

- Few cities currently outsource their computing services and few plan to in the future.

- More large cities use blanket procurement agreements than small cities, and 70% of those using such agreements are satisfied with them. About 75% of the cities are able to purchase computers under state agreements and feel that it "sometimes" allows purchasing at a lower price than on their own.

- Cities use a mix of methods to acquire computer applications. Overall, 75% of the cities purchase off-the-shelf packages, 59% contract out for house development (89%) than small cities (25%).

- About 61% of the large cities and 32% of the medium-sized cities, and 8% of the small cities have long-range IT plans.

Computer Use and Impact

- A significant proportion of cities report that top government officials now use computers; three-fifths or more report that mayor and council use computers; two-fifths report that the manager/CAO uses computers; and only 10% report that department heads use computers.

- Respondents rate their experience with computers very favorably, and see positive impacts for employee worklife, decision making, operational performance, and government costs. They see negative impacts of employee frustration.

- Less than two-fifths of the respondents perceive technical problems with computing, and usually less than one-half perceive behavioral problems. Inadequate training of personnel and underutilization of computer capabilities are key issues.

- Two-fifths of the cities see themselves as technologically progressive and their self-perceptions appear accurate when compared with their adoption of various information technologies.

- Cities tend to adopt infrastructure technologies rather than those which support internal staff or direct service delivery to citizens.

- Cities could get useful gains from their computing by a few simple actions: improve the efficiency of computing services, and devote more

Survey Response and Analysis

A total of 7,135 cities were surveyed by ICMA. The number of cities responding was 2527, for an overall response rate of 35%. The response rate did not vary significantly among cities of different population groups (Table 1). Moreover, the proportion of cities in the sample is approximately equal to their proportion in the population. Thus, the sample is broadly representative of the population of cities. However, the sample is heavily weighted towards small cities (under 25,000) which comprise 80% of the sample and the population (Table 1). This simply means that it is important to pay attention to city size when interpreting the data.

Table 1. Survey Response

	Population No.	*Respond -ing cities* No.	*Response rate* %	*Proporiton of total population* %	*Proportion of total response* %
No. reporting	7,135	2,527	35	100	100
Large cities: 250,000 and over	64	29	45	1	1
Medium-size cities: 25,000 - 249,999	1139	467	41	19	19
Small cities: Under 25,000	5932	2031	34	80	80

The respondents in small cities are primarily managers/CAOs or finance officers (63%); those in medium-size and large cities are primarily MIS/DP managers (66% or more). The respondents have been in their present job seven years on average, and three-fifths are men and two-fifths are women, with higher proprotions of women respondents in small cities.

Responses were examined by size, geographic region and metropolitan status. Only size was determined to be a consistent factor affecting differences in response, and therefore, nearly all responses are shown by size only. In addition, although the survey gathered data at 9 levels of population size, only 3 levels (and sometimes 5 levels) were used. This provides for ease of comparison with past surveys, but more importantly defines the natural breaks in the city responses.

County governments were not surveyed this year. Previous surveys have shown that the character of computing in cities and counties is nearly identical. The major differences lie in areas of computer application. Counties perform certain functions such as health and social services which most cities do not perform, and therefore cities are not representative in these areas. However, they are representative in most other areas covered by this survey (Kraemer, King, Dunkle and Lane, 1986). Therefore, as a matter of strategy, it was decided to focus on cities and to place emphasis on increasing the response rate, especially among the smaller cities where the number using computing is growing.

Those interested in recent information on computing in counties are referred to Patricia T. Fletcher, Stuard I. Bretschneider, and Donald A. Marchand, *Managing Information Technology: Transforming County Governments in the 1990's* (New York: Syracuse University, 1992). The report is available from the School of Information Studies, 4-206 Center for Science and Technology, Syracuse University, Syracuse, NY 13244-4100.

COMPUTER USE AND ORGANIZATION

Computer Use in Cities

The proportion of cities using computers continues to increase. Overall, about 97% of all U.S. cities use computers in 1993.

Comparison of these results with earlier surveys shows that computer use is spreading downward to the smallest cities (Table 2). For example, about 42% or more of the cities 10,000 to 49,999 in population used computers in 1975, about 93% used them in 1985, and 97% use them in 1993. There is no similar comparison possible for cities under 10,000 in population, but 93% of these cities use computers in 1993. It is likely that by the year 2000, there will not be a single city that does not use computers.

Table 2. Cities Using Computers*

	Response (N)			*Computing Users*			*Users as % (N)*		
	1975	1985	1993	1975	1985	1993	1975	1985	1993
No. reporting	2,294	754	2,465	1,777	732	2,348	51	97	97
100,000 and over..	157170	81	154	170	81	98	100	100	
50,000 - 99,999...	246273	124	227	273	124	92	100	100	
10,000 - 49,999...	1,891311	848	796	289	827	42	93	97	
Under 10,000*.... ...	...	1,412	...	...	1,316	...	...	93	

*Source for 1975 and 1985 data: Kraemer, King, Dunkle and Lane, 1986. The population breaks used in this table were dictated by this source.

There is no significant difference in the number of cities using computers by region of the country or metropolitan status of cities (data not shown).

Organizational Arrangements for Computing Use

Governments might use computing through a variety of organizational arrangements: in-house, shared, or outsourced (Table 3). Under *in-house arrangements*, the computer systems are owned by the government and operated by government personnel. Nearly all cities (95%) continue to use this arrangement, which has been the most common organizational form since computers were first introduced into local governments.

Shared arrangements involve one government providing services to others (e.g., Douglas County-Omaha) or several governments banding together to create a cooperative or nonprofit corporation (e.g., San Diego Data Processing Corporation) to provide computing services to the members. Very few cities (about 6%) use this arrangement currently, and very few have used it historically.

Outsourced arrangements involve government contracting out for computing services either in whole or part such as facilities management (contracting out for <u>all services</u>), service bureau (contracting for an application), contract programming (contracting for staff to develop an application), and time-sharing (contracting for computer time). Again, very few cities (about 3%) use this arrangement currently, and very few have used it historically. Usage is higher among the larger governments where the complexity and cost of computing sometimes causes local officials to turn to outsourcing as a solution to their frustrations with managing computing internally. The impression exists that outsourcing is on the rise because of a few "celebrity" cases in industry (Kodak, General Dynamics), and this may be the case. However, both current trends and history suggest it is not likely to become a big trend among cities in the future (see section on Management & Policy later). Orange County, California is one of the longest running, and apparently successful, examples of outsourcing in local government. It is also one of the few.

Table 3. Organizational Arrangements for Computing

	No.	*Use in-house arrangement* %	*Use shared arrangement with other governments* %	*Use service bureau/time-sharing arrangement* %
No. reporting	2465	95	6	3
250,000 and over.......	27	100	19	7
25,000 - 249,999.......	459	99	9	3
Under 25,000...........	1979	94	6	3

Location of In-House Computing Departments

While the most common organizational arrangement for providing computing services is the in-house computing department, cities vary in terms of the number of such departments they have and where they locate these departments. Two-thirds of the cities have a single computing department whereas one-third have multiple departments. As might be expected, large cities tend to have multiple departments whereas small cities tend to have a single department, or no formal computing department at all. The overall proportion of cities with multiple computing departments (33%) is somewhat higher than it was in 1985 (23%) indicating that cities have followed the general trend toward decentralization that characterized computing in organizations during the 1980's (data not shown). Among cities with one computing department, 38% are located in the Finance, 30% in Administration, and one-fourth are established as independent departments. About 6% are located in Public Works or another department (Table 4).

Table 4. Location of Computing Departments When Only One in City

	No.	*Independent depart-ment* %	*Part of finance* %	*Part of admin-istration* %	*Part of public works* %	*Part of another department* %
No. reporting	1585	95	6	3	1	5
250,000 and over.......	25	100	19	7	0	16
25,000 - 249,999.......	408	99	9	3	1	6
Under 25,000...........	1152	94	6	3	1	4

COMPUTING RESOURCES

Types of Computers Used

Cities might use mainframe computers, minicomputers, microcomputers, or a combination of all of these, and they do. The strongest finding about the type of computers used is that cities use a mix of computers rather than predominatly one type or another.

For analysis and presentation purposes, we combine mainframes and minicomputers into one category, and the various types of microcomputers into another category. All of the large cities (100%) use mainframes and/or minicomputers, whereas 92% of the medium-size cities do so, and 54% of the small cities do (Table 5). As might be expected, the large cities use more mainframes/minicomputers on average than the small cities.

There is a shift occuring in the use of computers in cities. Basically the shift is towards greater and greater use of microcomputers among all cities regardless of size. Ninety-two percent of all cities use microcomputers. The overall average is 34 microcomputers per city, but the average varies greatly by city size (Table 6).

Table 5. Types of Computers Used in Cities*

	No.	Mainframe/minicomputer %	Mainframe/minicomputer Average # mainframes/minis	Microcomputers %	Microcomputers Average # micros
No. reporting	2367	61	1	92	34
250,000 and over.......	28	96	3	100	655
25,000 - 249,999.......	461	92	2	94	96
Under 25,000...........	1878	54	1	91	11

*Source: Kraemer, King, Dunkle and Lane, 1986.

There is also a shift occuring from mainframes/minicomputers to microcomputers. The shift is not massive, but some change is clearly discernable. The shift is illustrated in Table 6 which shows the proportion of cities that "have abandoned" their mainframe or minicomputer for microcomputers, and "are considering" such abandonment. Overall, 14% of the cities indicate they have abandoned the larger computers for the smaller ones, and 18% indicate they are "considering" the shift. While the proportion of small cities considering the shift is the same as those that have already made the shift, the proportions for medium-sized and large cities are 2 and 3 times greater respectively.

Table 7 provides indication that the shift will be limited. About 30% of the larger cities (25,000 and above), which can reasonably be expected to need them, indicate they will purchase more of the larger computers and another 50% or more indicate they will purchase the same amount (replace what they have). Table 7 provides indication that the shift will be limited. About 30% of the larger cities (25,000 and above), which can reasonably be expected to need them, indicate they will purchase more of the larger computers and another 50% or more indicate they will purchase the same amount (replace what they have).

Table 6 Shift from Mainframes/minicomputers to Microcomputers

	Have abandoned mainframe/minicomputer for microcomputers No.	%	*Considering abandoning mainframe/minicomputer for microcomputers* No.	%
No. reporting	2283	14	1667	18
250,000 and over.......	28	14	23	57
25,000 - 249,999.......	462	11	386	24
Under 25,000...........	1793	15	1258	16

Table 7. Purchase Plans for Computers

	Mainframes/minicomputers				*Microcomputers*	
	Will purchase more		*Will purchase same*		*Will purchase more*	
	No.	%	No.	%	No.	%
No. reporting	258	19	672	41	1296	95
250,000 and over.......	7	30	14	64	23	100
25,000 - 249,999.......	95	28	181	50	315	94
Under 25,000...........	156	15	476	36	958	95

There is an interesting issue of how to interpret these data. For example, a question not asked in the survey is the extent to which cities have found a need to upgrade their microcomputers for minicomputers, or are considering such upgrades. The written comments of some respondents indicate that this is occuring as some cities outgrow their microcomputer systems, or cannot find the applications they seek for microcomputers but can find them for minicomputers. Given the assymetry in questions, interpretation of these data is complex. Do the responses illustrate that the mainframe dynasour is being replaced by the micro dynamo? To some extent, yes. But, clearly not to the extent that the media and some vendors might lead one to think.

The fact that the proportions that "have abandoned" the larger computers or "are considering it" do not change by city size suggests that there is some set of applications for which micros are a good substitute. However, the fact that the proportion considering abandonment is similar to the proportion that have abandoned (18% and 14% respectively) suggests that abandonment of the larger computers is not a dramatically growing phenomenon.

The reality is that there are some things that the larger systems do better than microcomputers, or that microcomptuers simply cannot do currently. Also, local governments have very large investments in the applications that run on mainframes and minicomputers. Even assuming that it is technically feasible to shift, moving these applications to microcomputers could be a very expensive, time-consuming, and painful process from which no real comparative advantage might be gained. For example, it was estimated that Douglas County, Nebraska would require 150 person years (30 analysts/programmers working 50 years) to replace their mainframe systems; it was similarly estimated that San Diego would require 220 person years (Irvine Research Corporation, *Right-Sizing Study of the Douglas County Computer Center* , Omaha, NE: Automated Information Systems, January, 1993; and San Diego Data Processing Corporation, *Technical Strategy*, San Diego, CA: SDDPC, 1992). Thus, city officials are well-advised to consider carefully the costs and benefits of radical shifts in computer technologies.

Types of Microcomputers Used

Most of the microcomputers used in city hall are IBM-PCs or compatibles (91%) rather than Apples/MacIntoshes (4%) or workstations (5%).[1] Put another way, there are about 20 times more IBM-PCs or compatibles in the cities than Apples/MacIntoshes or workstations (Table 8). However, among cities having each of these types of microcomputers (Table 9), the average number is 40 for IBM-PCs and compatibles (1922 cities), 12 for Apples/MacIntoshes (314 cities), and 8 for workstations (535 cities).

Table 8. Types of Microcomputers

	No.	*Average # micros*	*Total micros*	*% of total micros*
No. reporting	2527	34	84,802	100
IBM-PC and compatibles....	1922	40	77,072	91
Apples/MacIntoshes..........	314	12	3,605	4
Workstations.................	535	8	4,125	5

Table 9. City Size and Types of Microcomputers

		IBM-PCs & compatibles		*Apples/ MacIntoshes*		*Workstations*	
	Ratio of micros to employees	No.	Average # micros	No.	Average # micros	No.	Average # micros
No. reporting	1:8	1922	40	314	12	535	8
250,000 and over.......	1:93	25	727	15	47	16	8
25,000 - 249,999.......	1:19	404	102	118	18	123	11
Under 25,000...........	1:3	1493	12	181	4	396	7

The average number of workstations in cities is more or less the same regardless of size, whereas the average number of PCs and Apples is directly related to city size. This suggests that the demand and justification for the more powerful and expensive

[1]From question 2C, the IBM-PC and compatibles (1922 cities x 40.1 PC on average = 77,072, or 91% of the total of 84,802 machines in the sample cities). From question 2D, the Apples/MacIntoshes (314 cities x 11.48 machines on average = 3,605, or 4% of the total). From question 2E, the workstations (535 cities x 7.71 - 4,125 machines, or 5% of the total).

workstations, which are primarily used for engineering work (mapping, computer-aided design) and specialized applications such as GIS, is very much task-related.

The ratio of microcomputers to municipal employees provides a measure of the penetration of computing within city hall. The ratio for all cities is 1:8, but it varies by city size with the large cities having fewer microcomputers on a per employee basis than the small cities (Table 9). However, the large cities also have a large number of computer terminals attached to their mainframes and minicomputers, so the ratio of end user devices to employees is probably around 1:40 or even 1:20.

Local Area Networks (LANs)

About one half (48%) of the cities have local area networks (LANs) connecting at least some of their microcomputers with one another (Table 10). More of the larger cities have LANs than do the smaller ones. For example, all of the cities above 250,000 population have LANs whereas about two-fifths of the cities below 25,000 population have LANs. The large cities have about 10 times more LANs than the small cities, and the cities as a whole have 3 LANs on average. The number of large cities having LANs and the number of such LANs in these cities is interesting. This is because it is contrary to the impression created in much of the popular computing literature that only the smaller firms and smaller cities that are being innovative with computing, and that somehow the larger cities are trapped in the sunk costs and mindset of traditional mainframe computing. The figures about local areas networks, as well as the figures about minicomputers and microcomputers, suggest that the larger cities are much more dynamic and varied in their computing technology than commonly portrayed.

Table 10. Average Number of LANs

	No.	%	Average
No. reporting	1058	48	2.6
Population group.....			
250,000 and Over....	28	100	22
25,000 - 249,999...	461	73	3
Under 25,000.........	1920	42	2

Interconnection of Computers and Networks

Overall, about 60% of the microcomputers in cities are connected to LANs, with the proportion being greatest in the small cities (67%). This pattern is similar for mainframes and minicomputers (Table 11).

Three fourths of the mainframes/minicomputers are interconnected with local area networks. In addition, nearly two-thirds (64%) of the LANs are connected to one another such that electronic messages and data can be exchanged from one network to another. In short, there is a relatively high degree of interconnection between the various types of computers and the various types of networks in cities.

Table 11. Interconnection of Computers in Cities

	Micro to LANs		*Mainframe/mini to LANs*		*LAN to LAN*	
		Average % machines		*Average % machines*		*% cities with*
	No.	connected	No.	connected	No.	connections
No. reporting	1035	60	375	75	530	64
Population group......						
250,000 and Over.....	25	53	17	64		
25,000 - 249,999...	317	44	189	79		
Under 25,000.........	693	67	169	72		

The most common software used to support local area networks is Novell's Netware. About 70% of the cities report using this software whereas 12% report using IBM's OS/2 LAN Server and 5% report using Apple's Appletalk or Appleshare (data not shown). About one-fourth of the cities report using "other" LAN software. [These foregoing percentages exceed 100% when added because cities that have more than one network can use more than one type of network software.]

COMPUTING EXPENSES

Computing Expenses to City Expenses

Cities spend about 4% of their total operating budgets on computing. The proportion varies somewhat by city size, with the larger cities spending around 6% and the smaller cities spending around 2% percent. The comparable overall figure for counties is 4% of total operating budget (Fletcher, Bretschneider and Marchand, 1992). The comparable overall figure for services firms in industry is about 2% of total corporation revenues and 8% of total corporation operating expenses (Kraemer, Gurbaxani and Vitalari, 1993).

Table 12. Proportion of Computing Expenses to Operating Budget

	Cities		*Counties*		*Service firms*	
	No. Avg.	Avg. $/	No. Avg.	Avg. $/	No. Avg.	Avg. $/

		%	employee		%	empoyee		%	employee
No. reporting	606	4.1	.42	...	4	...	50	8	$7,800
Population group...									
250,000 and Over..	...	...*	...						
25,000 - 249,999	255	6.7	.75						
Under 25,000.......	351	2.3	.19						

*Only three cities in this population group responded to this portion of the questionnaire, and they responded incompletely. Therefore, we omitted this group because the data are of poor quality.

Budget Shares for Computer Resources[1]

The budget shares allocated to different computing resources such as hardware and personnel show change from earlier surveys. The major comparable change is in hardware spending which has declined from 27% of total computing expenses to 22% since 1985. Personnel expenses consume approximately 50% of the budget, and purchased software, outside services, and all other each consume about 10% (Table 13).

Computing Efficiency and Capital-Labor Ratios

A central issue in computing services provision is determining the relative efficiency of I/S units. The ratio of labor expenditures to capital expenditures is a useful measure of the internal productivity of computing departments. It says nothing about the return on investment or the business value of computing in the government as a whole, but it is useful for assessing the efficiency of a single computingdepartment over time, or comparing several departments at any point in time.

Labor refers to personnel expenses whereas capital refers to hardware expenses. The labor-capital ratio can serve as a useful management tool because it measures production efficiency. This ratio reflects the capital intensity of the production process underlying the delivery of information services.

Economists have used this measure with considerable success to explain differences in productivity in other sectors of the economy. In particular, it is argued that labor and capital are substitutes in production. That is, different ratios of labor and capital can be utilized to produce any given level of output. For a given set of labor and capital costs, there is an optimal ratio of labor to capital. As the level of capital to labor is increased towards the optimal point, output increases. However, when the optimal point is

[1]Responses to this portion of the questionnaire were very poor, mainly due to incomplete responses for personnel expenses. Consequently, in order to have a consistent analysis, we focused on that subsample of cities (690 all together) which provided data about personnel expenses and the other categories of expenses as well. We believe that the results are reliable because they fit with other previous analyses.

exceeded, the increases in productivity are too small to compensate for the costs of the incremental capital investment.

Labor-Capital Substitution and Computing Productivity. In the case of information systems, since the unit costs of hardware (capital) are dropping very rapidly relative to personnel costs, a critical method of improving the productivity of computing is by continually substituting capital for labor. However, it is difficult to determine the optimal ratio of labor to capital in the presence of rapidly changing costs and technologies.

In such circumstances, estimates of the labor-capital expenditure ratios for cities that are leading edge users of computing can have considerable value. These ratios provide a benchmark for computing managers who are trying to assess the productivity of their departments. In the absence of special circumstances, a ratio that is significantly higher than the norm suggests the possible existence of inefficiencies in the production of information services and should be further investigated. Moreover, the time trends in the ratio of these expenditures can also serve as a valuable planning tool for I/S managers who are trying to determine future levels of investment in hardware and personnel.

Labor-Capital Ratios for Computing. Cities spend about 2.3 times as much on computing personnel as on hardware (Table 13). Counties appear to spend 5.6 times as much on computing personnel as on hardware, but this is primarily an accounting artifact. Operating systems software and maintenance costs are included in the purchased software budget rather than in the hardware budget in the source study. Consequently, hardware spending is extremely low and throws off the labor-capital calculation. A better comparison in Table 13 is with services firms. Here the labor-capital ratio is 1.42.

The magnitude of this ratio and is consistent with other studies of computing budgets. These studies show that even though the unit costs of hardware have decreased at the rate of 20% per year, while personnel unit costs have increased slowly in inflation-adjusted terms, the ratio of these expenditures is about 1.5 on average, and has not changed in the last five years (Kraemer, Gurbaxani and Vitalari, 1993), or even in the last 15 years (Gurbaxani and Mendelsson, 19xx).

The knowledge that labor-capital expenditure ratios have stayed relatively constant around 1.5 is a useful benchmark which should be of particular significance to computing managers who are responsible for estimating future hardware capacity and staffing requirements.

Expectations About Future Budgets

About 60% of the cities expect their budgets for computing to be the same next year, whereas 18% expect a decrease and 22% expect a decrease (data not shown).

Among those expecting a decrease in computing budgets, 75% indicate they will cut expenditures for hardware, 60% indicate they will cut expenditures for purchased software, and 27% indicate they will cut expenditures for outside services. Only 13% indicate they will cut expenditures for personnel.

Table 13. Distribution of Budget Shares

	Cities *% of total* budget	*Counties** *% of total* budget*	*Services Firms* *% of total* budget**
No. reporting	(609)	...	(50)
Hardware.............	22	10	29
Personnel.............	51	56	43
Purchased software..	8	23	8
Outside services......	11	...	9
All other..............	8	11	11
Total..................	100	100	100
Labor/capital ratio.....	2.3	5.6	1.42

*Source: Fletcher, Bretschneider and Marchand, 1992. n.a. means not available; "outside services" was not used as a data collection category in the study.
**Source: Kraemer, Gurbaxani and Vitalari, 1993.

Computing Personnel

As might be expected, the number of computing personnel in cities is directly related to population. On average, all cities have about 8 computer personnel, but the large cities have 72 and the small have 5 computer personnel (Table 14). As with computing expenses, it is possible that these figures underreport the number of city staff serving in computing roles. This is because some staff in the user departments perform computing functions for themselves and others but are not counted as part of the city's computing personnel.

Table 14. Average Number of Computing Personnel

	1975		1985		1993	
	No.	Average	No.	Average	No.	Average
No. reporting					927	8
Population group.......						
250,000 and Over......					25	72
25,000 - 249,999...					326	9
Under 25,000...........					576	5

COMPUTER APPLICATIONS

Areas where Computers are Used

The uses of computers can be distinguished between two broad areas: (1) those which are common and cross functional lines such as word processing or spreadsheets (Table 15), and (2) those which are specific to the various functional areas of government (Table 16).

Common Areas. The common areas where computers are *currently* used by 50% or more of the cities include: word processing, graphics, budget analysis, budget development, spreadsheets and database management. The only notable differences between areas of use by type of computer system are two: more cities currently use micros for graphics and and database management than use the larger computers for these activities. Three common areas stand out where computers are *planned* for use within the next two years by at least one-fifth of the cities. These are electornic mail, geographic information systems (GIS), in-house publishing.

Functional Areas. The functional areas where computers are *currently* used by 50% or more of the cities include: finance, utility services, personnel, administration/office support, and law enforcement. Microcomputers tend to be used more in certain areas historically left out by the larger systems--planning and community development, engineering, fire, parks and recreation, and libraries.

One functional area stands out for *future* computer use. Land records management is planned for computer use by 14%/22% (mainframe/micros)of the cities within the next two years; personel by 17%/15% of cities; public works by 13%/18% of the cities; and planning and community development by 14%/17% of the cities.

Table 15. Common Areas where Computers are Currently Used

	Type of Computer System			
	Mainframe/minicomputer		*Microcomputer*	
Applications	*% Currently* Use	*% Plan to* Use	*% Currently* Use	*% Plan to* Use
Word Processing	53	10	93	5
Graphics	14	15	65	17
Budget analysis	69	13	63	11
Budget development	71	14	63	11
Strategic planning	10	11	23	18
Spreadsheets	31	11	84	8
Electronic mail	23	21	17	25
Statistical analysis	14	9	35	11
In-house publishing	8	8	45	21
Database management	40	10	57	14
GIS	11	31	20	40

Table 16. Functional Areas of Computer Application

	Type of Computer System			
	Mainframe/minicomputer		*Microcomputer*	
Applications	*% Currently* Use	*% Plan to* Use	*% Currently* Use	*% Plan to* Use
Finance	88	6	55	8
Utility services	73	5	35	8
Personnel	65	17	40	15
Administration	42	7	54	8
Land record management	27	14	20	22
Law enforcement	52	10	56	11
Public works	33	13	49	18
Engineering	15	7	38	12
Planning & development	19	14	39	17
Transportation	8	6	14	8
Fire department	25	9	45	8
Social services	6	4	8	4
Voter registration	18	3	12	5
Parks and recreation	20	9	38	10

Library	15	6	26	6

MANAGEMENT POLICY

Decision Makers for Acquisition of Information Technology

There are many city officials who might become involved in decisions about the acquisition of information technology, ranging from the MIS/DP director to the department heads to the city manager to the mayor and council. An indirect indication of the relative role of these different actors is the proportion of respondents that identify them as decision makers. Using the proportion of officials that 50% or more of the respondents report as being involved in acquisition decisions, there are three key actors. These are the city manager or chief administrative officer, the MIS/DP director, and department heads (Table 17).

Moveover, the relative role of these three actors varies by size of city. In cities under 25,000 population, 56% report the city manager as decision maker; no other role is identified by 50% of the respondents. In cities 25,000-249,999 population, 70% report the MIS/DP director as decision maker; again, no other role is identified by 50% of the respondents. And in cities 250,000 and over, 89% report the MIS/DP director and 64% report the department heads as decision makers. The dynamics of decision making undoubtedly are more complex than suggested by this comparison, but it is likely that this caricature captures much about the relative influence of different actors.

Table 17. Decision Makers for the Acquistion of Information Technology*

	No.	*Manager/ CAO* %	*Department heads* %	*MIS/DP director* %	*User committees* %
No. reporting	2387	53	43	24	10
Population group.....					
250,000 and Over....	28	36	64	89	21
25,000 - 249,999....	463	38	46	70	19
Under 25,000........	1896	56	42	12	8

*The Mayor and Council Members were also listed as decision makers and were identified by 21% and 41% of the cities respectively. They are not included in the table because in no case did the proportion of respondents identifying them reach 50% and because there was no variation by city size.

Procurement Practices

Use of outsourcing. Although outsourcing is frequently offered as a way of reducing expenditures, or "holding the line" on computing expenditures, very few cities now contract out for services. It was shown earlier that at most 9% of the cities now contract out for services if one considers shared arrangements with other governments plus the use of service bureaus and time-sharing arrangements (Table 3). It was also shown earlier that about 11% of computing budgets are spent for "outside services", which includes contracts for training, software development, time-sharing, etc. (Table 13).

It also appears that cities do not expect to contract out computing services in the future. Only 2% indicate they are "likely" or "very likely" to consider contracting out whereas 93% indicate they are "unlikely" or "very unlikely" to consider it (data not shown).

Many cities do contract out for application development (59%) in addition to making their own applications and buying others off-the-shelf (Table 19). There are primarily two areas where cities currently acquire computer applications by contracting out and where they plan to in the future, regardless of the type of computer system used. These two areas are Geographic Information Systems (GIS) and engineering (e.g., calculations, computer-aided design, computer-aided drafting).

Use of state government contracts. Approximately 75% of the cities can purchase computers under state government contracts. Repondents feel that such contracts "sometimes" rather than "always" or "never" allow purchasing at a lower price than on their own. There are no significant differences by city size.

Use of blanket procurement agreements for microcomputers. Overall, only about 10% of the cities have blanket procurement agreements for microcomputers (Table 18). And the use of blanket agreements is directly related to city size with 57% of the large cities having such agreements and only 7% of the small cities having such agreements. However, given that the small cities have only 10 microcomputers on average, and that price competition for microcomputers is keen, this practice probably makes sense for these cities. However, the larger cities probably use blanket agreements because they have additional bargaining power given the larger size of their procurements and because blanket agreements can be an indirect way of achieving standardization of technology platforms.

Table 18. Use of Blanket Procurement Agreements

	Microcomputers		*Blanket Procurement Agreement*	
	No.	Average %	No.	Average %
No. reporting	2527	34	2386	59
Population group.....				
250,000 and Over....	29	655	28	57
25,000 - 249,999...	467	96	464	19

Under 25,000.........	2031	10	1268	7

Overall, 70% of the cities that use blanket procurement agreements are satisfied or very satisfied; 23% are neutral, and only 7% are dissatisfied or very dissatisfied. Generally, more of the larger cities are dissatisfied with blanket procurements than are the smaller cities. The primary reasons for dissatisfaction are:

Failure to deliver equipment according to specifications
Failure to deliver on time
Lack of flexibility
Poor quality equipment
Poor quality of support
Slow responsiveness in dealing with problems
Lack of a single point of contact for problems and issues that arise.

The primary factor that respondents identified for these problems is the emphasis by city officials on accepting the "lowest bid" in blanket procurements rather than the "best overall bid".

Acquisition of Computer Applications

Methods of Acquisition. Cities might obtain computer applications by two principal methods: make or buy. Making your own applications involves having an in-house systems development staff. Buying applications usually involves the purchase of packaged applications (whether off-the-shelf, or requiring some customization) or contracting out for development. Cities use all three methods of acquiring software rather than primarily one or the other. About 75% of the cities use off-the-shelf packages, 59% contract out for development, and 34% use in-house development.

The difference among cities in the use of these methods is not great, except in one area--the proportion of large cities using in-house development (89%) is much greater than that of small cities (25%). The reason for the difference is mainly in the type of computer systems used by large and small cities. Most small cities predominantly use microcomputers where a large inventory of software exists and does not require customization. In contrast, large cities use mainframes and minicomputers in addition to microcomputers and have a legacy of their own applications built over 10-20 years or longer.

Table 19. Acquisition of Computer Applications

	No.	*In-house development* %	*Off-the-shelf* %	*Contract out for development* %

No. reporting	788	34	75	59
Population group.....				
250,000 and Over....	25	89	93	61
25,000 - 249,999....	313	68	86	54
Under 25,000........	450	25	72	60

Long-Range Plan for Information Technology

Overall, only 13% of the cities have a long-range information technology plan. However, this figure is misleading because of the large number of small cities in the sample that probably don't need a long-range IT plan. After all, the smaller cities have only 10 microcomputers on average, and usually only microcomputers, which probably doesn't call for a long-range plan. On the other hand, 32% of the medium-sized cities and 61% of the large cities do have IT plans. For the larger cities especially, the scope, scale, complexity and level of IT investment clearly warrant the making of long-range plans. Moreover, there is probably advantage in making such plans for all but the small cities because a long-range IT plan can provide useful information such as:

Inventory of existing technology.
Identification of technology standards in place and needed.
Explicit statement of strategy for use and deployment of the technology.
Identification of department and user needs related to the strategy.
Estimate of costs of enhancing, replacing or deploying additional technology.
Justification for the "business case" for the investment.
Procurement and implementation schedule.

Table 20. Long-Range Plan for Information Technology

	Have a long-range plan for IT	
	No.	Average %
No. reporting	2305	13
Population group.....		
250,000 and Over....	28	61
25,000 - 249,999...	449	32
Under 25,000.........	1828	8

The pattern of involvement in long-range IT plans is similar to that for decision making about acquisition of information technology shown earlier in Table 17. Four actors appear to be especially important in decisions about long-range IT plans--city manager/CAO, finance director, MIS/DP director, and department heads. However, their importance varies with city size as it did earlier (Table 21). In small cities 57%, 59% and 54% of the respondents report the city manager/CAO, department heads and finance director respectively as decision makers. In medium-sized cities, 80% report the MIS/DP director and 73% report department heads as decision makers; no other role is identified by 50% of the respondents. And in large cities, 94% report the MIS/DP director and 56% report department heads as decision makers. Thus, it appears that a clearly defineable and limited number of actors are key decision makers on information technology matters, even though others might participate in some fashion on some decisions or aspects of decisions.

Table 21. Decision Makers for Long-Range IT Plans

	No.	*Manager/ CAO* %	*Department heads* %	*Finance director* %	*MIS/DP director* %	*User committee* %
No. reporting	152	51	65	48	59	32
Population group.....						
250,000 and Over....	6	38	56	19	94	31
25,000 - 249,999....	66	46	73	45	80	43
Under 25,000........	80	57	59	54	34	21

COMPUTER USE AND IMPACT

Actors that Use Computers

When computers were first introduced, they were used primarily by municipal staff and computer staff rather than the city's management or elected officials. However, the pattern of use has been changing as computing has penetrated further into the municipal organization, and as computers have become easier to use. Today, a significant proportion of cities report that top government officials use computers. Three-fifth or more of the cities report that the mayor and council use computers, and two-fifths or more report that the manager/CAO uses computers (Table 22). The most surprising finding is the low proportion of cities reporting that department heads use computers (11%). There is not much difference in who uses computers between type of computer system or city size.

Table 22. Actors that Use Computers

		Proprotion Using Mainframe/minicomputers					
		Manager /CAO	*Mayor*	*Council*	*Depart-ment heads*	*MIS/DP director*	*Assistant manager/ /CAO*
	No.	%	%	%	%	%	%
No. reporting	1506	41	31	63	11	83	31
Population group.....							
250,000 and Over....	26	46	50	58	8	81	50
25,000 - 249,999....	422	45	47	80	14	85	47
Under 25,000........	1058	39	24	56	10	82	24

		Proportion Using Microcomputers					
		Manager /CAO	*Mayor*	*Council*	*Depart-ment heads*	*MIS/DP director*	*Assistant manager/ /CAO*
	No.	%	%	%	%	%	%
No. reporting	2035	57	78	68	11	92	37
Population group.....							
250,000 and Over....	27	44	93	93	15	96	67
25,000 - 249,999....	451	53	87	93	12	96	57
Under 25,000........	1557	58	75	60	11	90	31

Perceived Impacts of Computing

Rating of Overall Experience with Computers. Respondents rate their experience with computers very favorably. For those with mainframes/minicomputers, 82% indicate their overall experience has "met" or "exceeded" expectations (data not shown). Those with minicomputers are even more favorable, with 90% indicating their experience has "met" or "exceeded" expectations. Given this favorable overall view about computers, it is interesting to examine where the respondents perceive benefits from computer use.

Perceived Benefits of Computers. In general, most respondents feel that computers have positive impacts for employee worklife, decision making, operational performance, and government costs (Table 23). At least 51%, and often considerably more, of the respondents agree or strongly agree that computer use has improved employee job performance, creativity, and morale (employee benefits) even though it also increases frustration (about 40%). A full 80% or more feel that computer use improves decision making and enables in-depth analysis (decision making benefits). Three-fifths or more feel that computer use has improved communication, timeliness and quality in govenrment (operational performance). And about 70% feel that computer use reduces costs even though they do not feel that it eliminates jobs (about 15%).

The greatest difference in perceived impacts between mainframes/minicomputers and microcomputers is in employee worklife. One-half or more of the respondents feel that mainframes enhance employee creativity and morale, whereas 71% or more feel that microcomputers have these positive benefits.

Table 23. Perceived Impacts of Computing

		Operational Performance			**Cost**	
		Improves communica -tion	*Improves timliness*	*Improves quality*	*Reduces cost*	*Eliminates jobs*
	No.	% agree	% agree	% agee	% agree	% agree
Impacts with mainframe/ minicomputer	1495	70	87	88	70	37
Impacts with microcomputer	2041	70	87	92	72	15

		Decision Making		***Employee Worklife***			
		Improves dcision making	*Enables tn-depth analysis*	*Improves job perform -ance*	*Increases frustra -tion*	*Improves employee morale*	*Enhances employee creativity*
	No.	%	%	%		%	%
Impacts with mainframe/ minicomputer	1495	79	70	94	39	56	51
Impacts with microcomputer	2041	83	85	96	33	71	89

Perceived Problems with Computing. Less than two-fifths of the respondents perceive technical problems with computing, and usually less than one-half perceive behavioral problems with computing (Table 24). There are two exceptions in the behavioral category: personnel training and utilization of equipment capacity. Personnel training is reported as a problem with microcomputers by 57% of the respondents and with mainframes/minicomputers by 50% of the respondents. Underutilization of equipment capacity is reported as a problem with microcomputers by 55% of the respondents.

Our field research in cities provides insights into what is at issue here, and the way in which these two problems might be interrelated. Assuming resistance to use is not an issue, underutilization of microcomputer capacity results from both the nature of work and the lack of adequate training. Most municipal employees do not work on microcomputers more than 4-6 hours per day; many do not even work on their microcomputers that many hours. The reason is that people do many different things in their jobs. Even intensive computer users must also attend meetings, visit field sites, answer telephones, etc. Moreover, intensive computer uses do not utilize the full capacity of their hardware or software when they do use the computer. A detailed study of computer use showed that most people use about 10% of the capabilities of the software with which they are <u>most familiar</u>. One of the reasons they do not use more is that they don't need it. Modern software packages, such as word processing packages, are designed for broad markets, and therefore the software comes with far greater capabilities than most people need most of the time.

However, it is also the case that most people could use more of the hardware and software capabilities at their disposal than they do use. The primary reason they do not use more of the capabilities is the lack of adequate training, both initially and after initial use. In a study of computer use among 3,000 municipal employees, it was found that computer literacy was significantly correlated with computer use for a wide range of tasks (e.g., updating files, record searching, text processing, graphics, statistical analysis, financial calculations, programming). It was also found 30% of municipal employees are self-taught, 37% taught by co-workers, and 33% taught by computer professionals. Who did the training *initially* was not important, but *after initial use* formal training through courses was found to be very significantly correlated with greater computer use. Thus, city officials could signficantly increase computer utilization by providing more training for employees (Northrop, Kraemer, Dunkle and King, 1993).

Table 24. Perceived Problems with Computing

		Proprotion Having Technical Problems				
		Equipment performance	*Equipment reliability*	*Vendor service*	*Software availability*	*Integrating the micro-computer*
	No.	%	%	%	%	%

Problem with mainframe/ minicomputer	1183	23	13	26	39	28
Problem with microcomputer	1444	17	14	24	11	19

Table 24. Perceived Problems with Computing (cont.)

		Proportion Having Behavioral Problems				
		Personnel training	*Resistance to use*	*Resistance to organizational change*	*Under-utilization of capacity*	*Other*
	No.	%	%	%	%	%
Problem with mainframe/ minicomputer	1183	50	34	34	42	2
Problem with microcomputer	1444	57	36	32	55	3

FUTURE DIRECTIONS FOR TECHNOLOGY

Forty percent of the cities consider their communities technologically progressive, 20 % consider themselves static, and 40% consider themselves in the middle. These self-characterizations appear to be consistent with the reality of technologies actually in use or being considered. Although on average across all cities, only one of 18 possible information technologies are being used and and another one being considered, the cities that characterize themselves as technologically progressive are using more of the technologies that those who characterize themselves as technologically static by a factor of x to 1 (Table 25).

Table 25. Use of Information Technologies by Progressiveness

	Citizen/public technologies		*Intrastructure technologies*		*Staff support technologies*		*All technologies*	
	Using	Consid -ering	Using	Consid -ering	Using	Consid -ering	Using	Consid -ering

	No.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.
No. reporting	2167	.13	.36	1.12	1.68	.73	.80		
Progressiveness group									
Very progressive	876	.20	.55	1.64	2.18	1.05	.96		
Progressive	870	.08	.26	.84	1.40	.55	.70		
Static	421	.07	.18	.62	1.21	.42	.70		

Cities are also making choices about the kinds of technologies they are using. To illustrate these choices, the technologies are grouped into three categories as follows (Table 26):

1. Citizen/public technologies which support direct service delivery to citizens. These include: 24-hour city hall, video arraignment, smart traffic monitoring systems, smart-coded tool booths and parking, and smart highways.

2. Staff support technologies which support the internal administration and operation of the government. These include: scanners, imaging, interactive video training, finger print ID, bar code technology and electronic mail.

3. Infrstructure technologies which support greater technical sophistication and innovation. These include: portable computers, fax board in computers, CD ROM, multimedia, optical disk, virtual reality, smart public buildings, wireless LANs, wide area networks, fiber optics, and GIS.

On average, the cities are currently using more of the available infrastructure technologies than citizen/public technologies or staff support technologies. And they are also "considering" using more of the infrastructure technologies. Thus, their plans for future use of information technology are largely oriented towards building information infrastructure rather than towards staff support or direct service delivery to citizens.

Table 26. Use of Information Technologies by City Size

		Citizen/public technologies		*Infrastructure technologies*		*Staff support technologies*		*All technologies*	
		Using	*Consid -ering*	*Using*	*Consid -ering*	*Using*	*Consid -ering*	*Using*	*Consid -ering*
	No.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.	Avg.
No. reporting	2527	.1	.4	1.1	1.6	.7	.8	1.0	1.4
Population group..									
250,000 and Over..	29	1.0	1.6	4.9	3.6	2.9	.8	4.4	3.3

25,000 - 249,999.	467	.3	.9	2.6	3.1	1.6	1.3	2.5	2.7
Under 25,000....	2031	.1	.2	.7	1.2	.4	.6	.6	1.1

DISCUSSION AND CONCLUSION

The character of computing in cities continues to exhibit a mix of stable and changing patterns. Continuity and stability is illustrated in the following features uncovered in the survey and analysis:

Continued provision of computing primarily through in-house computing departments rather than through outside arrangements

Continuing role for mainframes and minicomputers, at least in those cities that already have a legacy of computer applications built on these systems

Stable distribution of spending for computing, particularly between hardware and personnel expenses

Benefits that accompany computer use primarily in the areas of decision making, operational performance, and employee worklife

Continuing roblems that accompany computer use, primarily in the areas of user training and user frustration with continual changes in the technology.

Discontinuity and change is also illustrated in other features such as the following:

Steady growth in number of cities using computers

Spread of computing to smaller and smaller cities

Spread of computing within cities to more functions and to more end users

Shift to microcomputers in all cities

Upgrading from microcomputers to minicomputer systems

Abandonment or consideration of abandonment of mainframe/minicomputer among some cities

Growing proportion of total computing budgets in cities that is outside the computing departments and in the user departments

Newer applications of computing provided by microcomputers that are not provided by mainframes/minicomputers or at least not provided as well in the areas of word processing, spreadsheets, graphics, and desktop publishing to mention a few

Increased overall spending for computing

In short, computing in cities continues to be a dynamic phenomenon even while it exhibits certain enduring features. While dynamic, the change is evolutionary rather than revolutionary. It is built up from many small changes in many parts of city hall over a long period of time. Taken together over a longer period of time, these many small changes may yet constitute a revolution in the sense of a paradigm shift or technical shift of major proportions.

When compared with counties and with service firms in industry, cities appear to be doing as well as these peers in most areas where comparisons are possible. However, there are two areas where considerable gains might be made by small improvements: efficiency of computing departments and provision of training and support for end users.

It appears that the efficiency of computing departments could be improved because the labor-capital ratios appear high relative to services firms in industry. However, these relationships require further analysis that also looks at the relation of investments in computing to broader municipal outcomes. The respondents views of the benefits of computing suggests that effectiveness has been achieved. It may well be that this has been achieved at the cost of some efficiency, but that it has been a positive tradeoff on balance. The efficiency of computing departments probably needs to be examined further and actions taken with respect to the management of computing. Depending upon the situation, these might include actions such as consolidation of hardware and staff, standardization of technology platforms, centralized management of local area networks, centralized provision of end user training, use of contract programmers, greater use of packaged applications, and closer examination of the efficiency and effectiveness of spending by user departments for their own computing (outside of the city's computing department).

The provision of more training and support for end users could result in substantial gains in personal productivity and reduction of employee frustration with computing. Although the respondents indicate that the benefits of computing are positive, they also indicate that there is considerable frustration surrounding computing. The written comments of respondents point to employee frustration with computing more than any other single impact. The comments specifically identified the following aspects as frustrating: initial use of the computer or of new applications; loss of files; loss of work through user errors; problems due to errors or "bugs" in the software; overuse of the computer for things better done manually; poorly written manuals; lack of time to learn on one's own; lack of formal training; and lack of top management support for training time or resources. All of these frustrations point to the need for more training, for training beyond initial use, and for more "help" support for users on an on-going basis. Such training would not only relieve user frustrations, but would also increase the productivity and effectiveness of municipal managers, professionals and staff.

The 1993 ICMA Survey of Computer Technology in Local Government is a rich storehouse of information. There are many interesting relationships in these data which could not be explored within the space of this chapter. For example, the patterns of small cities are sufficiently varied to warrant examination in a separate report. Similarly, the realtionship between management practices and computing benefits warrants separate examination. Future papers and reports in the ICMA *Data Briefs* and *Urban Data Service Reports* will elaborate the data presented here, and will present further analyses.

REFERENCES

Fletcher, Patricia T., Stuart I. Bretschneider, and Donald A. Marchand, *Managing Information Technology: Transforming County Governments in the 1990's* (New York: Syracuse University, 1992).

Irvine Research Corporation, *Right-Sizing Study of the Douglas County Computer Center* (Omaha, NE: Automated Information Systems, January, 1993).

Kraemer, Kenneth L., Vijay Gurbaxani and Nicholas Vitalari, *Performance Benchmarks for Information Systems in Corporations* (Irvine, CA: Center for Research on Information Technology and Organizations, University of California, 1993).

Kraemer, Kenneth L., John Leslie King, Debora Dunkle and Joseph P. Lane, *The Future of Information Systems in Local Governments* (Irvine, CA: Public Policy Research Organization, University of California, 1986).

Northrop, Alana, Kenneth L. Kraemer, Debora Dunkle and John Leslie King,, *Management Policy for Greater Computing Benefits: The Versatility of Training* (Irvine, CA: Center for Research on Information Technology and Organizations, University of California, 1993).

San Diego Data Processing Corporation, *Technical Strategy*. (San Diego, CA: SDDPC, 1992).

Scoggins, John, Thomas H. Tidrick and Jill Auerback, Computer Use in Local Government, *Municipal Yearbook* (Washington, D.C.: International City Management Association, 1985), pp. 33-45.