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An Analytical Overview of Urban Information Systems in the United States

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AN ANALYTICAL OVERVIEW OF URBAN INFORMATION SYSTEMS IN THE UNITED STATES

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Preface

The use of computers in urban management is a subject of increasing interest among IIASA's member nations. This interest reflects the belief that the vast data storage and retrieval capabilities of today's electronic digital computers when combined with modern techniques of management hold great promise in improving the quality and effectiveness of urban policymaking.

To explore the potential role that IIASA might play in reviewing and disseminating the current state-of-the-art in the use of computerized information systems in urban management, the Human Settlements and Services Area invited a leading authority on the subject, Dr. Kenneth Kraemer of the U.S.A., to visit IIASA and offer recommendations on desirable courses of action. This Research Memorandum, an expanded version of Dr. Kraemer's lecture at IIASA, outlines the basic concept and design of the URBIS (Urban Information Systems) Project directed by Dr. Kraemer and concludes with a discussion of the contribution that IIASA might make in this field.

A. Rogers
Chairman

Human Settlements
and Services Area

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Abstract

Urban governments are becoming increasingly interested in modern management techniques such as computerized information systems. This paper presents an analytical state-of-the-art review of the uses, impacts and problems of computer technology in local governments in the United States. It reports the results of a questionnaire survey conducted by URBIS (Urban Information System) Research Group, University of California at Irvine to determine the uses of computer technology and the policies governing those uses within local governments. The organization and research strategy of the URBIS Project is presented by way of introduction and is followed by a discussion of the role IIASA might play in the study of Urban Information Systems.

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AN ANALYTICAL OVERVIEW OF URBAN INFORMATION SYSTEMS IN THE UNITED STATES[1]

I. INTRODUCTION

It is fascinating to think about the new and ingenious ways systems theory and analysis can be applied to understanding our world and accomplishing tasks. Yet it also is interesting and worthwhile to study the present-day results of what earlier systems thinkers have brought forth. Certainly, one of the premier examples of applied systems concepts widely in use today is the computerized information system. One finds these systems in every sort of organization and in nearly every country in the world. Much has been written and said about the impacts of these systems on the organizations that use them, often in context of performing some specific task, and usually in regard to operations such as manufacturing, commerce, engineering, and science. But computers offer promise to other kinds of organizations as well, and are being used in many ways that have never been the focus of detailed study.

One of the most important but little studied subjects is the application of computers to the task of managing urban governments. Nearly every nation today is concerned with problems of urban areas--overcrowding, housing shortages, pollution, traffic congestion--and in many cases it has been proposed that use of modern management techniques such as computerized information systems might alleviate some of these problems [14, 16]. No doubt the technology holds greater promise than we now make use of, but in order to further capitalize on use of computerized information systems in urban management, three kinds of efforts must take place. First, there must be a commitment to research and development in applying computer technology to help meet the needs of urban planners, policymakers, and managers. Second, ways must be found to encourage dissemination of successful applications of computer technology to those urban governments that need them. Finally, periodic examination and documentation of the results of these efforts must be undertaken to evaluate successes and failures and to provide guidance for the future. This paper discusses an example of the latter kind of effort.[2]

This paper is based upon results of the URBIS Research Project, a multi-year study of the uses and impacts of computer technology on local governments in the United States. This project is being carried out by a team of researchers at the Public Policy Research Organization of the University of California, Irvine.[3] Support for the project is from the Research Applied to National Needs Division of the U.S. National Science Foundation, and endorsement and assistance in the project has come from a variety of urban public-interest groups in the United States, including the International City Management Association, the National League of Cities, the U.S. Conference of Mayors, the National Association of Counties, and Public Technology, Incorporated.

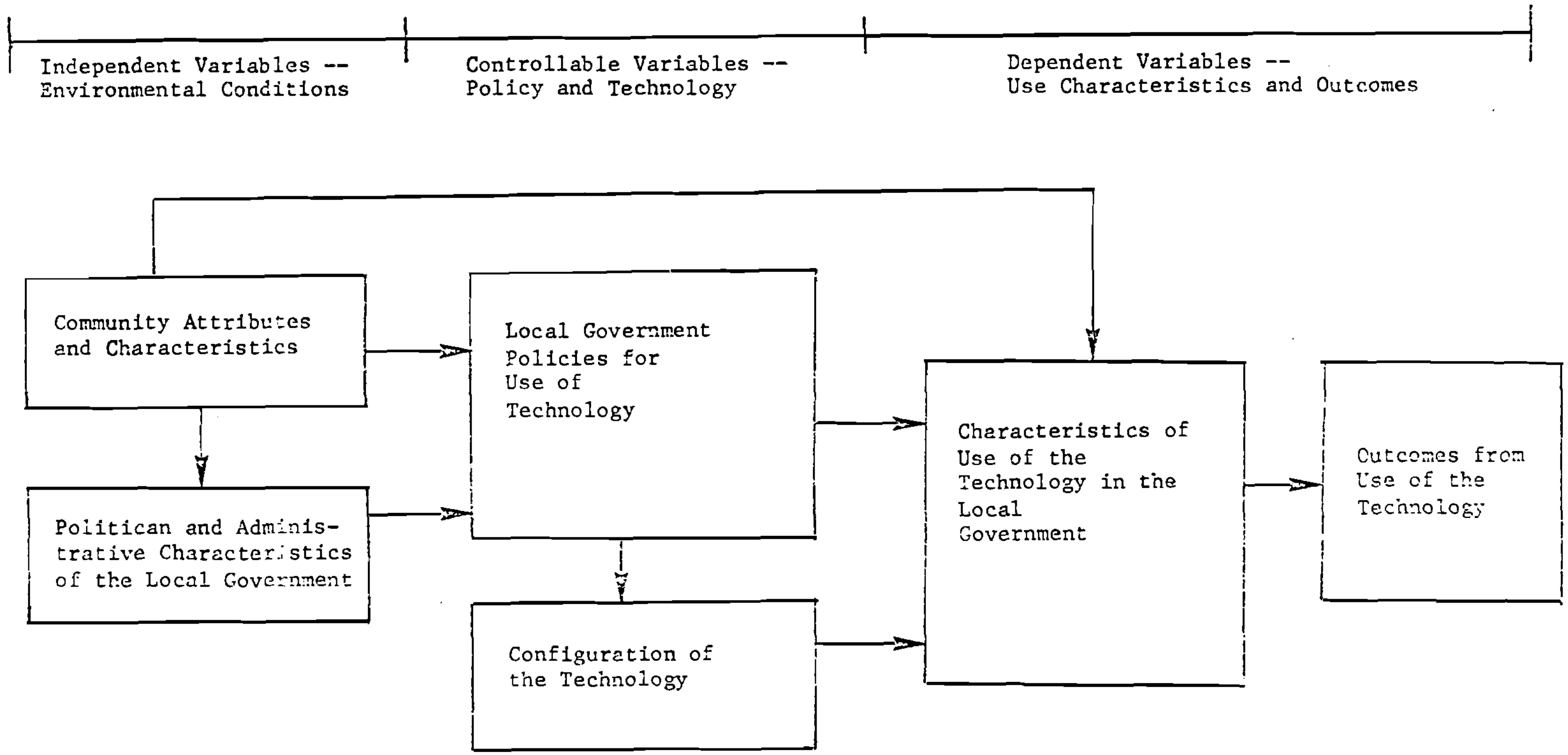
This paper presents the basic concept and design of the URBIS Project, discusses data on the state-of-the-art in urban information systems from the recently completed first phase of the project and will conclude with a discussion of the role that the International Institute of Applied Systems Analysis might take in further study in this important field.

II. THE URBIS PROJECT

The URBIS Project was begun in 1974 with the mandate to study how computer technology is being used in local governments, what impacts those uses have in the governments, and what might be done to improve the contributions of the technology to meeting the challenges to urban areas. Several characteristics of the URBIS Project make it unique and interesting. First, the project is an example of evaluation research. It seeks to collect data on current states, and to relate those data to some paradigm of what ought to be in order to evaluate those current states. Second, the project is an example of policy research. It focuses, ultimately, on evaluating the policies for use of computer technology in the governments. Third, it is a multi-stage project using an innovative statistical sampling strategy designed to collect and analyze data both on the conditions in the current set of cities and to create a hypothetical set of preferred characteristics that would obtain in "future cities" [18]. Finally, this research is deliberately both empirical *and* prescriptive. It not only seeks to discover what is the case, but what should be the case as well. Thus, the project is seen to be valuable at two levels: as a needed study of information systems in urban governments; and as an example of a policy research strategy that can be applied effectively to a wide range of public policy issues.

An illustration of the concept underlying the URBIS Project can be seen in Figure 1. The project design uses three classes of research variables: environmental or independent variables; controllable or policy-technology variables;

Figure 1. INTERACTIONS BETWEEN ENVIRONMENT, TECHNOLOGY, POLICIES, AND OUTCOMES



and dependent or outcome variables. Environmental variables describe the basic demographic, political, administrative, and financial characteristics of the cities studied, and are considered to be unchanging in the short-run. The environmental variables form the foundation of any description of the city, and determine certain other city characteristics. Controllable variables are those policies for utilization of computer technology and the configurations of the technology that are malleable by city officials in the short-run. They usually develop based on the conditions provided by the environmental variables, but are not completely dictated by particular environmental characteristics (i.e., there is considerable flexibility in these variables in all cities). The outcome or dependent variables are the effects that are presumed to be "caused" by the interplay of the environmental and policy-technology variables. By measuring these outcome variables, it is possible to assess the impact of particular policy and technology configurations, given particular environmental characteristics. It is expected that cities with problems and undesirable impacts from use of computing will be able to improve their computing operations by adopting policies of those cities with similar environmental characteristics and positive experiences with computing.

Environmental variables include community attributes such as population size, growth rate, city age, local financial base, need for local poverty-related services; and the political-administrative characteristics of the city such as form of government, level of reformed political institutions, policy focus of decision making, and distribution of political decision making. The "controllable" variables include basic organizational policies such as centralization of control over decisions, management support of computing activity, user involvement in computing activity, quality of data processing personnel, pricing policies for computer use, investment level in data processing, and restrictions on computing activities due to finances. Also, the controllable variables include characteristics of the technology itself, such as the degree of computerization, sophistication of automation, degree of data sharing within the city, the degree of data consolidation, and the extent of computer utilization. The outcome variables include measures of how the technology is actually used by individuals in the government, as well as measures of the impacts of computerization on delivery of services to citizens, on decision making among top city management, and on the work environments of municipal employees.

The project is being carried out in two phases, with a third phase follow-on planned. Figure 2 shows these phases and their purposes. In the first phase, from which the data in this paper were taken, the objective was to collect comprehensive data on the uses of computing technology and the policies governing those uses within the individual governments. Preliminary indications of the impacts of the technology were gathered from the chief executive officers of the governments. It was desirable in this phase to establish a reliable profile of the "state-of-the-art" of computer use in local governments, so the research was carried out as a census survey including all U.S. cities over 50,000 in population and all countries over 100,000 in population. The research instruments were three fairly lengthy questionnaires to be completed by the local government data processing managers (who each completed two questionnaires) and by the local chief executives (who each completed one questionnaire) [19,20,29]. Of the 713 cities and counties in the population surveyed, responses were obtained from about 75 percent--a remarkably high return rate for a study of this magnitude.

The second phase of the study, for which data have just recently been collected, focuses on establishing the relationships between local government characteristics, such as the size of the government and its wealth base, with the kinds of computer technology each has, and with the policies each uses for its information systems. These correlates are, in turn, correlated with a set of outcome measures to produce an environment-policy-technology-outcome profile. With such a set of profiles for the policies under study, the objective is to develop contingency recommendations for policymakers. For example, the study might show that large cities with council-manager form of government and need for highly specialized computing in its various departments will benefit from a policy of centralized control over computer acquisition, but decentralized computer systems and employment of analysts and programmers by user departments. The second phase data were collected from a wide variety of individuals in site visits to 40 cities selected for study based on a set of pre-defined characteristics revealed from Phase I data.

The data bases collected from these two phases are very large. Together, they contain approximately two million data elements.[4]

Figure 2. URBIS RESEARCH PHASES

PHASE I	PHASE II	FOLLOW-ON
Census Survey Research in 713 Local Governments Cities 50,000 Population Counties 100,000 Population	Policy Survey Research in 40 Local Governments Selected from Phase I	Longitudinal Case Studies in 5 - 10 Local Governments Selected from Phase I & 2
Exploratory Case Studies	Case Study in Selected Sites to Provide Contextual Information	

III. THE STATE-OF-THE-ART IN URBAN INFORMATION SYSTEMS

Three aspects of the state-of-the-art in urban information systems will be discussed in this section: the extent and uses of computer technology; the impacts of computer technology; and problems with computer technology. A summary section will provide a perspective on the findings in these three aspects.[5]

Extent, Use and Organization of Computer Technology

Extent of Computer Technology

Computers are used rather extensively in U.S. local governments (Figure 3). Over half of the cities and counties with populations exceeding 10,000 now use computers. Proportionately more large cities and counties use computers than do small, with nearly 100 percent of the very large cities and counties (populations greater than 250,000) using computers. This difference can be seen as a function of adoption of computing in Figure 4, which shows that computer adoption varies according to government size, and that the pattern of adoption approximates the logistic curve, characteristic of innovation diffusion [4]. Computing capability also varies greatly, with larger governments having much greater capacity as measured by number of computer mainframes, computer core capacity, time-sharing capability and number of applications operational (Figure 5). This is certainly not surprising, given that the needs for computing capability probably vary directly with the size of the local government. A distribution of the kinds of computer mainframes used by local governments is presented in Figure 6, clearly showing the dominance of this market by IBM.

Figure 3. U.S. CITIES AND COUNTIES USING COMPUTERS

Classification	No. of governments[a] (A)	Governments using EDP No.	Governments using EDP % of A
Total, all cities	2,294	1,179	51%
Population group			
500,000 and over	26	26	100
250,000-499,999	31	31	100
100,000-249,999	100	97	97
50,000- 99,999	246	227	92
25,000- 49,999	535	310	58
10,000- 24,999	1,356	488	36
Total, all counties	2,199	1,181	54%
Population group			
500,000 and over	56	54	96
250,000-499,999	68	66	97
100,000- 249,999	164	146	89
50,000- 99,999	330	261	79
25,000- 49,999	568	297	52
10,000- 24,999	1,013	357	35

[a] The number of governments using computers among cities over 50,000 and counties over 100,000 is precise. For those smaller cities and counties, the number of governments using computers are estimates. Utilization of EDP in these smaller governments may be higher than shown in the table due to a low response rate among these respondents.

Figure 4. CUMULATIVE PERCENTAGE OF U.S. CITIES AND COUNTIES UTILIZING COMPUTERS, BY YEAR OF ADOPTION AND POPULATION, N = 485 CITIES and 412 COUNTIES

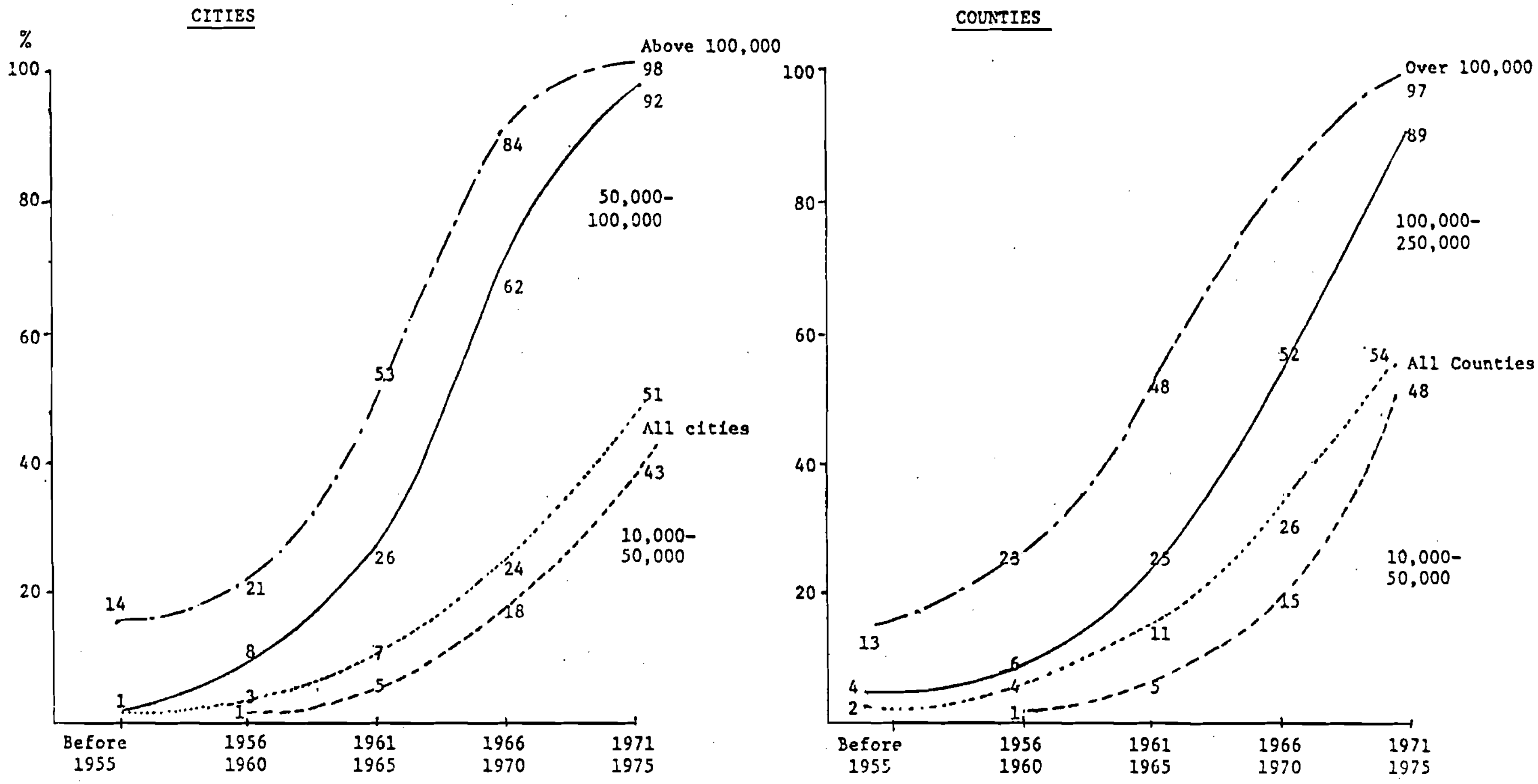
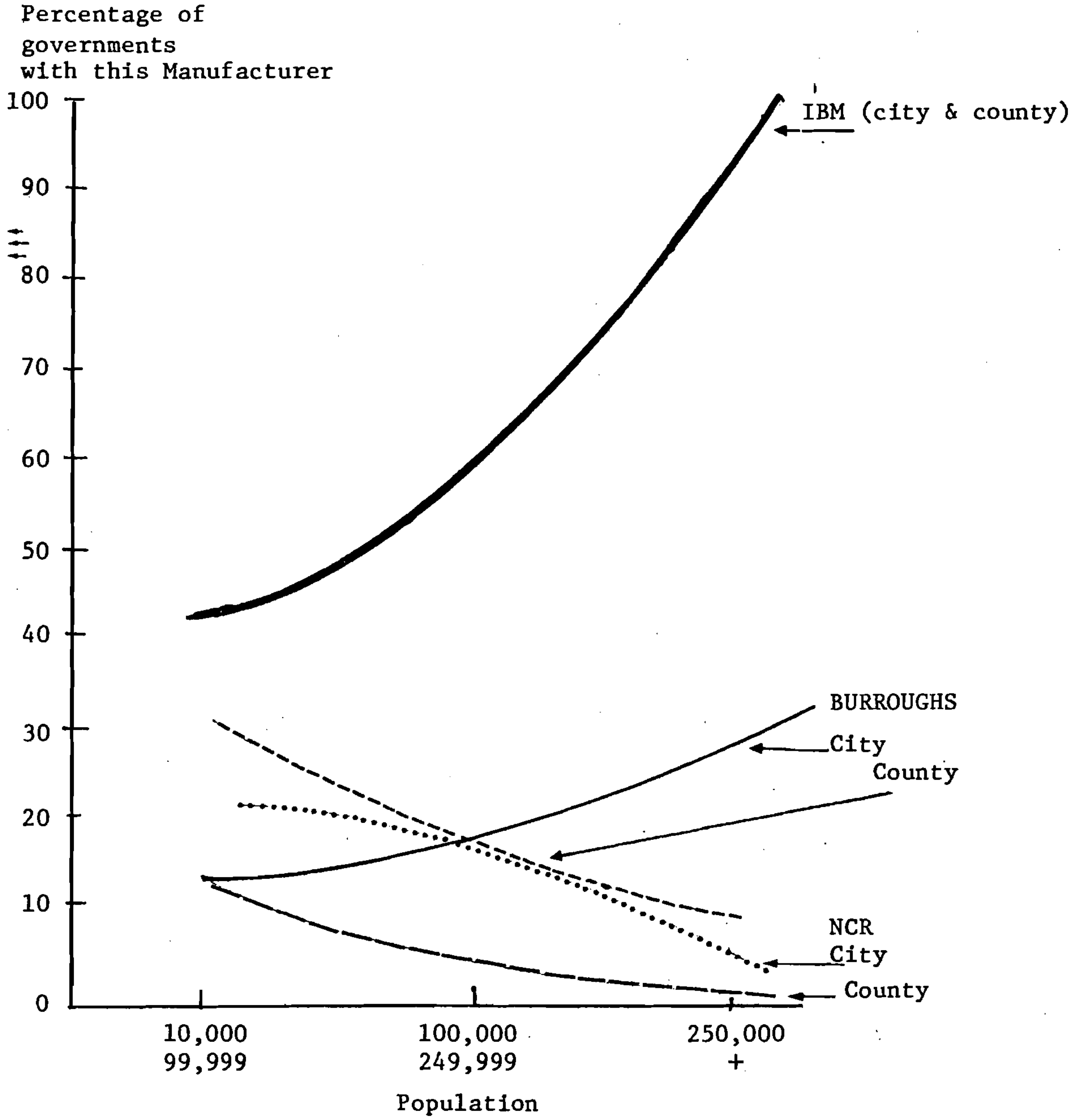


Figure 5. SELECTED CHARACTERISTICS OF COMPUTING EQUIPMENT AND OPERATIONS FOR U.S. CITIES AND COUNTIES, BY POPULATION

Classification	Number of governments reporting	Average number of CPU's	Average total core capacity in bytes	Media total core capacity	Average number of CRT terminals	Average number of automated applications currently operational
All cities	647	1.2	165K	94K	8	31
Population group						
500,000 and over . . .	19	4.0	1962K	1536K	71	65
250,000-499,999 . . .	25	2.1	554K	328K	19	41
100,000-249,999 . . .	76	1.5	217K	144K	6	38
50,000- 99,999 . . .	169	1.2	71K	32K	1	23
25,000- 49,999 . . .	174	1.1	54K	22K	...	...
10,000- 24,999 . . .	184	1.0	27K	16K	...	...
All counties	277	1.4	338K	160K	14	32
Population group						
500,000 and over . . .	39	2.5	1494K	676K	37	47
250,000-499,999 . . .	50	1.5	312K	196K	15	36
100,000-249,999 . . .	97	1.3	155K	64K	4	24
50,000- 99,999 . . .	47	1.1	57K	24K	...	...
25,000- 49,999 . . .	32	1.0	48K	24K	...	...
10,000- 24,999 . . .	12	1.0	36K	16K	...	...

Leaders (...) indicate not reported

Figure 6. DISTRIBUTION OF COMPUTER MAINFRAME MANUFACTURERS IN U.S. CITIES AND COUNTIES, 1975, BY POPULATION[a]



[a]Other mainframe manufacturers, such as Honeywell, Digital Equipment Corporation, and Univac do not appear on this chart because their machines are in limited use in the local governments surveyed.

Another useful indicator of the distribution of computing activity over governments of varied populations is through comparison of expenditures for data processing. Figure 7 presents several expenditure indicators as functions of population. Overall, local governments in the United States spend between .5 and 1.7 percent of their operating budgets on data processing activity, with the smallest governments spending proportionately less than the largest, and the largest spending proportionately less than the medium-sized governments. It appears that the largest governments might be achieving an economy of scale not attained by the medium-sized governments, although there may be other explanations for the bell-shape of the expenditure by population curve. In spite of the relatively small percentage of local government budgets consumed by data processing, the figure for total data processing expenditures by governments above 10,000 in population is in excess of $300,000,000 annually [19, p. 18]. And, this figure is probably underestimated. Many "hidden" costs for data processing, such as added personnel costs for user departments, are not recorded as data processing expenditures [33].

Uses of Computer Technology

Computers are put to a wide variety of applications in local governments, and again, the average number of computer applications per government increases as a function of local government size. Figure 8 shows this relationship for both operational applications (those that are currently being used) and applications planned for operation within the next two years. The largest cities (over 500,000 in population) average 65 operational applications and the largest counties average 47 applications.

Figure 7. U.S. CITY AND COUNTY COMPUTING EXPENDITURES, 1975, BY POPULATION

CLASSIFICATION	Total governments reporting (N)	Average budgeted expenditures for data processing installation(s) (in thousands)	Average EDP expenditure as a % of total operating budget	Average computer hardware expenditure as a % of total EDP budget	Average total EDP personnel	
					EDP Dept.	User Depts.
Total, all cities	984	$ 224	1.0%	38%	22.0	5.9
Population group[a]						
500,000 and over.	20	3,084	.9	38	112.5	30.1
250,000-499,999	26	1,069	1.0	41	39.2	11.2
100,000-249,999	75	598	1.2	37	19.6	5.7
50,000- 99,999	174	197	.8	39	7.6	1.2
25,000- 49,999	266	66	.6	...	...	...
10,000- 24,999	423	28	.5	...	...	...
Total, all counties	378	$ 487	1.3%	37%	37.8	10.2
Population group						
500,000 and over.	39	2,708	1.4	34	95.6	26.3
250,000-499,999	52	811	1.7	45	29.6	9.1
100,000-249,999	91	292	1.3	34	14.3	3.4
50,000- 99,999	75	76	.6	...	...	...
25,000- 49,999	58	42	.5	...	...	...
10,000- 24,999	63	25	.6	...	...	...

[a] These figures are probably underestimates due to incomplete responses from some of the multiple installations in these cities.

The smaller cities (100,000-249,999 in population) average 38 operational applications and the smaller counties average 24 applications. Some differences between the profiles of cities and counties are notable, primarily the fact that the increase in number of operational applications by size is considerably greater in cities than in counties, and that planned applications are somewhat more ambitious in cities than in counties. These facts indicate that counties move more slowly with development of applications than do cities, probably because county applications tend to be larger undertakings in most cases (e.g., voter registration, public welfare, public health, and courts are usually county functions).

These differences in kinds of applications developed in cities and counties are demonstrated more clearly in Figures 9 and 10 [5]. These figures indicate the relative development of applications by measures of "commonality," or the percentage of local governments reporting at least one application in a particular functional area such as police or courts, and "intensity" which is the average number of applications within each functional area among local governments that report at least one application in that area. Thus, applications low to the left are relatively undeveloped in local governments; those high to the left are partially developed in many local governments; those high to the right are extensively developed in many local governments; and those low to the right are extensively developed in a few local governments.

It quickly becomes clear that certain kinds of applications dominate both city and county data processing. A large fraction of those applications

Figure 8. NUMBER OF COMPUTER APPLICATIONS "OPERATIONAL" AND "PLANNED WITHIN TWO YEARS" IN LOCAL GOVERNMENTS, 1975, BY POPULATION

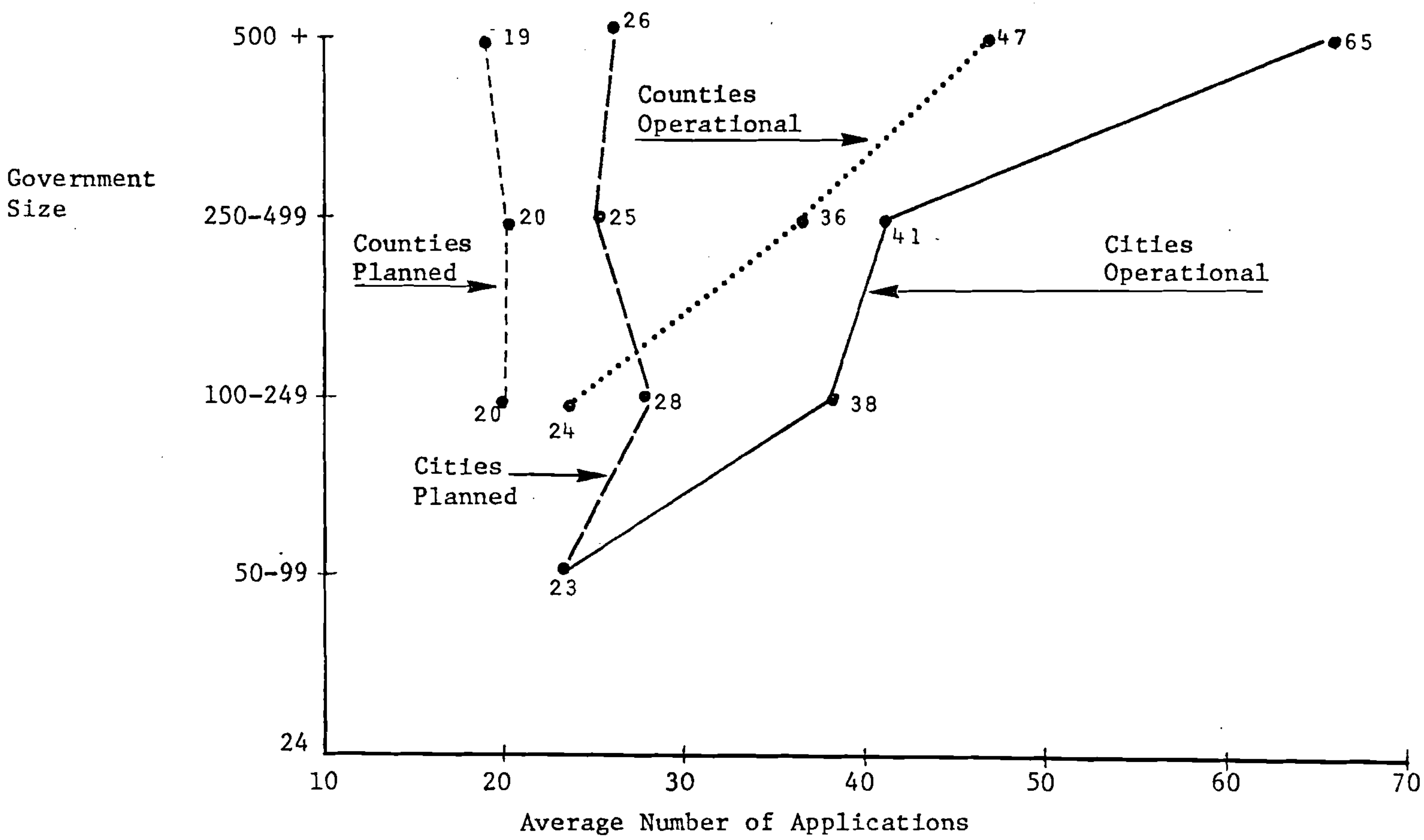
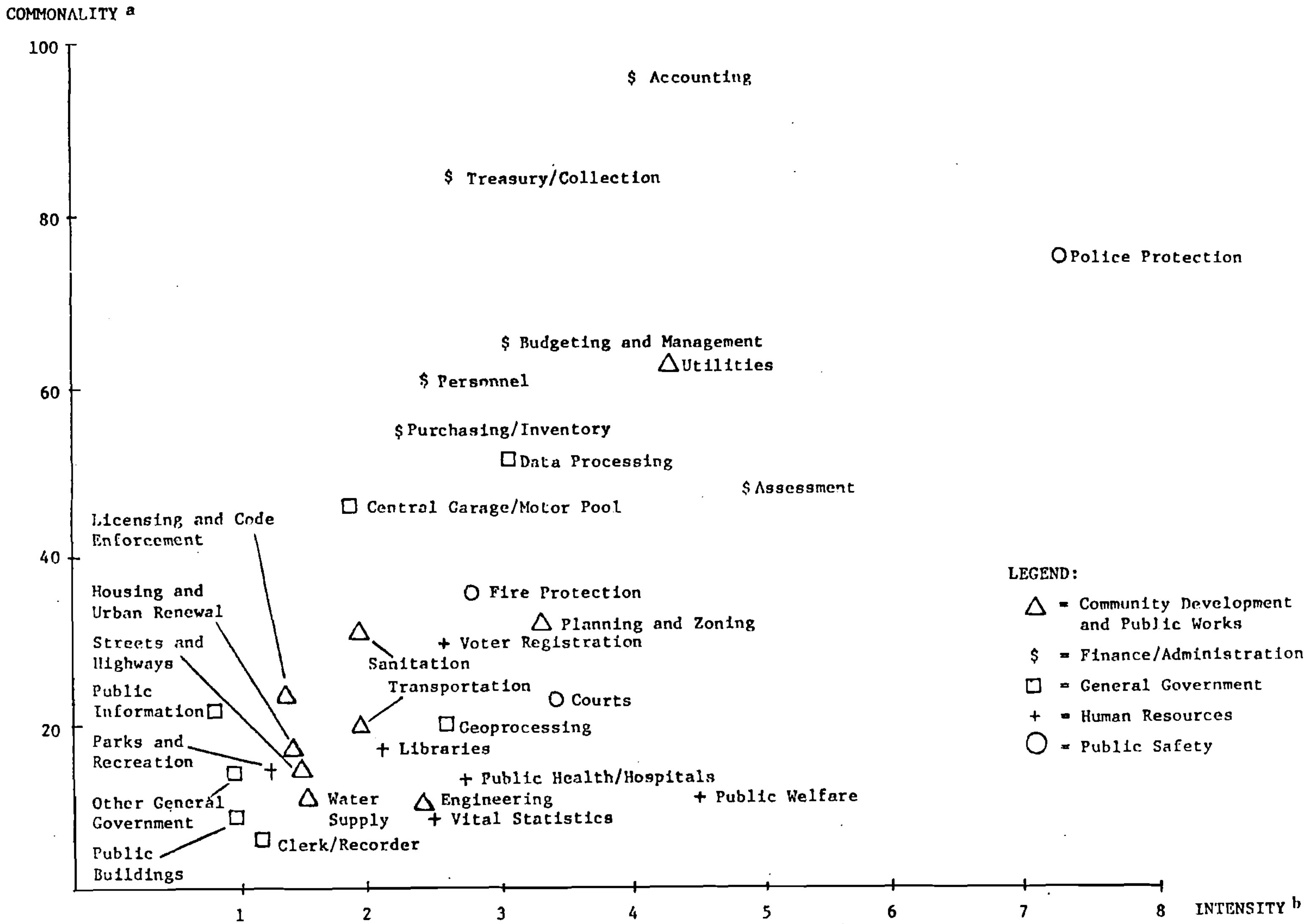


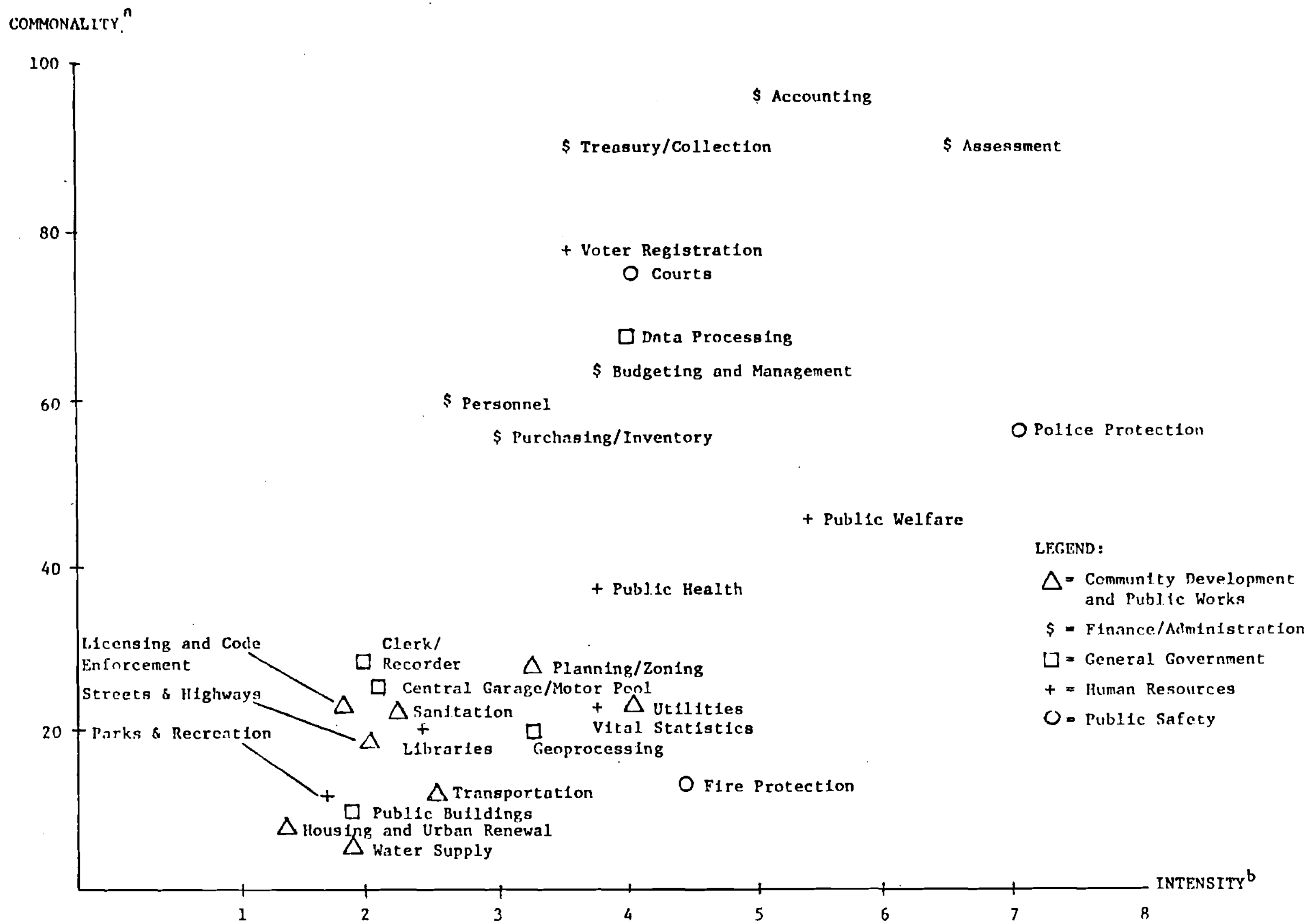
Figure 9. PROFILE OF OPERATIONAL APPLICATIONS IN U.S. CITIES OVER 50,000 POPULATION, 1975



[a]Commonality equals the percent of all cities reporting the current use of EDP which have one or more operational applications in this area.

[b]Intensity equals the average number of operational applications in the functional area for all cities with one or more applications operational in this area.

Figure 10. PROFILE OF OPERATIONAL APPLICATIONS IN U.S. COUNTIES OVER 100,000 POPULATION, 1975



[a]Commonality equals a percent of all counties reporting the current use of EDP which have one or more operational applications in this area.

[b]Intensity equals the average number of operational applications in the functional area for all cities with one or more applications operational in this area.

with substantial development in many governments are in the finance area. Police applications tend to be the most intensively developed, although the range of governments that have them is smaller than with financial applications. A large number of functional areas show little development in both cities and counties, such as housing, libraries, parks and recreation, and sanitation. Some functional areas are more developed in counties, such as assessment, public welfare, public health, voter registration, and courts. Others are more developed in cities, such as fire protection and clerk/recorder activities. These differences generally reflect differences in responsibility for provision of various local government services.

Organization of Computer Technology[6]

Most local governments have a range of options for procuring computer services. The three most common are to: perform data processing in-house using the government's own staff and purchased, rented or leased equipment; join together with other local governments in a shared computing effort, using some mix of their own and other governments' resources; and, contract with a private service bureau for services. Figure 11 shows the percentages of local governments that make use of these various arrangements, broken down by population. This figure indicates that the likelihood of a government doing its own in-house data processing increases with population size, while the likelihood of using a private service bureau is inversely related to size. Use of public regional, or shared, installations is fairly uniform over all sizes of local governments, although among cities there might be a slight propensity for smaller governments to use this arrangement.

Figure 11. PERCENTAGE OF U.S. CITIES AND COUNTIES USING VARIOUS ARRANGEMENTS FOR COMPUTING SERVICES, BY POPULATION[a]

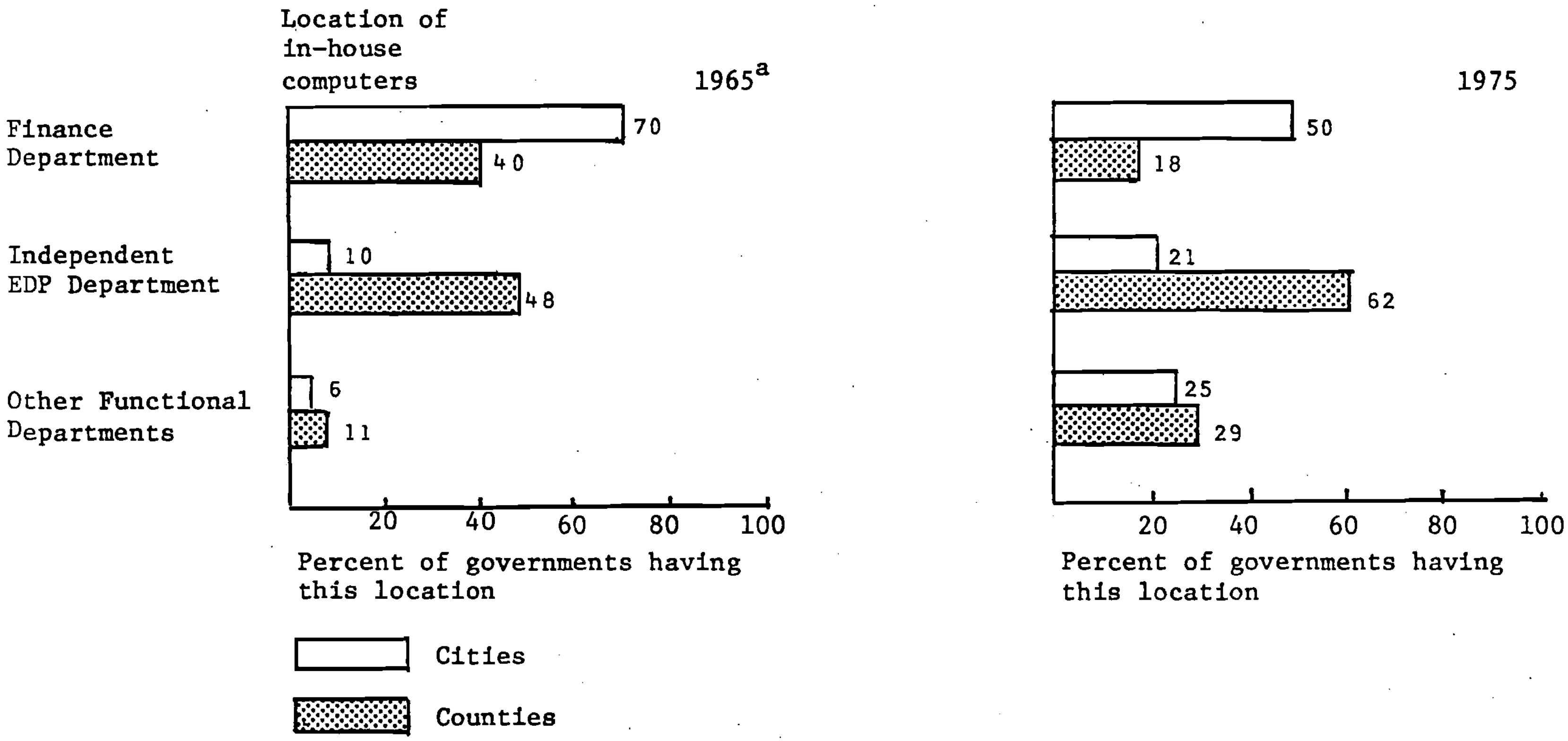
Classification	Total governments reporting (N)	Percent of governments with: In-house data processing %	Facilities management organization %	Public regional installation %	Private service bureau %
Total, all cities	1,088	65	0	14	41
Population group					
500,000 and over	20	100	0	10	15
250,000-499,999	28	93	0	21	11
100,000-249,999	79	90	4	8	11
50,000- 99,999	178	75	0	12	24
25,000- 49,999	300	64	0	18	47
10,000- 24,999	483	54	0	13	51
Total, all counties	565	59	0	11	33
Population group					
500,000 and over	39	90	3	13	8
250,000-499,999	55	87	2	5	11
100,000-249,999	101	73	0	18	19
50,000- 99,999	129	49	0	15	36
25,000- 49,999	108	51	0	6	43
10,000- 24,999	133	44	0	8	48

[a]Total row percentages add to over 100% owing to some governments using multiple sources.

Among those governments that now perform data processing operations in-house, there are several arrangements for locating computing activity. Because early computer applications were devoted almost exclusively to financial affairs, many governments first located their computers in the finance department. Subsequently, as computers have proven useful in a wider range of local government operations, there has been a trend to move the computing operation out of the finance department and into an independent data processing unit, or other appropriate departments. Figure 12 shows this trend, based on data taken from 1965 studies and the 1975 URBIS data. Clearly, the computer is ceasing to be regarded as a tool of finance, and is in many places considered as a functional activity in its own right. Moreover, there may be a trend toward more decentralization of computing to user departments, encouraged by development of a wide range of applications and made possible by decreasing costs of computer hardware.

In summary, computers are used fairly extensively in U.S. local governments, and their use is increasing all the time. By all measures of use, including year when computing was first adopted, expenditures, sophistication of capability, number of applications, and whether or not computing operations are done in-house, the primary correlate is local government size. Larger local governments got started earlier, spend more (subject to possible economies of scale), have more applications, and have more capability. Nearly all the larger local governments have adopted computer technology. Smaller governments, on the other hand, are just now in or are entering a period of rapid growth in use of the

Figure 12. DEPARTMENT LOCATION OF COMPUTING AMONG U.S. CITIES AND COUNTIES THAT DO COMPUTING IN-HOUSE, 1965 and 1975.



[a]Data from Willis, J.A. The status of ADP in city government, The Municipal Yearbook, 1965. Chicago: International City Management Association, 1965; and Bezzel, J.E., Control and Use of EDP systems, American County Government, 32 (February, 1967), 20-23-28.

technology. It is reasonable to estimate that within 15 years nearly all local governments larger than 10,000 population will be using computers in some way. The average number of applications large and small governments operate will likely increase for quite some time, since the potential of computer assistance to the full range of local government functions is still unexploited.

Impacts of Computer Technology

As mentioned at the beginning of this paper, several preliminary measures of computer impacts in local governments were collected in the first phase of the URBIS Project. These measures were primarily the opinions of chief executive officers in local governments--mayors, city managers, county administrators and county board chairmen. Although the opinions of these individuals provide only a partial profile of the impacts from computer technology, they are the most accessible measures and provide some very interesting findings [19, pp. 24-27].

This section is organized topically, concentrating on various kinds of impacts computers have had. These topical areas of impact are six: impacts on service delivery to citizens, impacts on privacy and disclosure, impacts on productivity in local administration, impacts on decision making by top executives, impacts on the work environment of government employees, and impacts on planning for local futures. A general summary discussion will follow these topical discussions.

Impacts on Services Delivery to Citizens

Very few instances of direct services to citizens from computing have been found in the URBIS research [13]. The vast majority of impacts on citizens come indirectly, through improvements in the mechanisms by which services are delivered. There are cases where computers provide almost direct citizen service, for example, as with computerized files of stolen property identifiers that facilitate police efforts to return confiscated stolen property to rightful owners. But, most citizen contacts with computers come through the mail in the form of notices or bills for municipal taxes or utilities. These facts can be ascertained simply by studying the nature of applications and the distribution of applications in Figures 9 and 10.

Some idea of the general impacts of computer technology on citizens is provided through two questions shown in Figure 13. These preliminary data from Phase II of the URBIS study indicate the perceptions of municipal officials and staff--chief executives, department heads, and staff in police, planning and finance agencies--in 40 cities. Most officials and staff (59.3%) felt computers sometimes create problems for citizens due to the time required to correct inaccurate computer files, while a minority (41%) felt that citizens' complaints about departments are sometimes related to problems with the computer. In both cases, however, the percentages indicate the presence of a problem in at least 41 percent of the governments surveyed--a figure that should be lower if the computer is to be an aid to production of citizen services.

Impacts on Privacy and Disclosure

An important and controversial concern related to computer impacts on citizens is in the area of personal privacy and disclosure of personal information held by the government. There are two potential problems

Figure 13. U.S. CITY OFFICIALS AND STAFF VIEWS OF EDP IMPACTS ON CITIZENS

	% of Municipal Officials and Staff Indicating:			
Type of Impact	Agree	Somewhat Agree	Somewhat Disagree	Disagree
Computers sometimes make things hard for citizens because mistakes in computer records take a long time to correct. (N = 2231)	28	32	22	18
Citizen complaints about this department are sometimes related to foul-ups or problems we have with the computer. (N = 2269)	18	23	16	43

with information that might be related to privacy and disclosure [12]. First, there is the danger that sensitive personal information stored in a record might be disclosed to those who have no right to see it and who might use it in a way that abridges the rights of the subject of the information. Second, there is the prospect of unlawful or improper denial of access to records information held by the government. This may be denial of access to the subject of the records, or to others who have a legitimate interest in what is contained in the records.

According to chief executives, computerization of records has not had much impact on the actual incidence of privacy and disclosure problems for any given group that might be affected (Figure 14). However, an adjusted total of all governments that have had at least one problem of privacy or disclosure related to at least one of the groups indicated reveals that nearly one-fifth (19%) have had problems. More importantly, chief executives strongly feel that individuals have a right to control information kept on them by their governments, and most feel that local governments should establish guidelines and mechanisms to control collection, use, and dissemination of information on individuals (Figure 15). The impact of computers on privacy and disclosure, therefore, should be considered a matter of potential difficulty that has not surfaced in a serious way.

Impacts on Productivity in Local Administrations

The impact of computers on governmental productivity is one of the most important areas of study [2]. Since a primary reason for using computers is to save resources and improve efficiency of operations. Chief

Figure 14. U.S. CITY AND COUNTY CHIEF EXECUTIVE EXPERIENCES WITH PRIVACY, CONFIDENTIALITY, AND DISCLOSURE PROBLEMS[a]

Type of Group or Interest	% of Chief Executives Claiming This Group has Complained about: Collection or Release of Personal Information	Being Denied Access to Records of Information
Individuals named in records	11	17
Professional, civic or community groups	11	7
Local government employees	7	10
Federal or state government agencies	2	3
Adjusted Total[b]	19	

[a] Percentages indicate the proportion of the 571 respondents noting the problem.

[b] This Adjusted Total is the percentage of all governments that had at least one problem of privacy or disclosure related to at least one of the groups or interests.

Figure 15. U.S. CITY AND COUNTY CHIEF EXECUTIVE ATTITUDES TOWARD CITIZEN CONTROL OF PERSONAL INFORMATION

	% of Chief Executives Indicating:				
Areas of Citizen Control	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
"Citizens have the right to control information kept on them by government officials including how it is used, stored and disseminated" (N = 561)	33	40	17	9	1
"Local governments should establish guidelines and implement mechanisms to control collection and dissemination of personal information on citizens" (N = 564)	23	36	19	11	6

executives responded to three questions measuring productivity. As shown in Figure 16, only a minority of the chief executives believe that computers have generally reduced costs or reduced staff in situations where they have been applied. Contrarily, a very large percentage indicate that computers have generally increased the speed and ease of performance in governmental operations. This presents an interesting conclusion. Apparently, the chief executives have little confidence in the propensity of computers to impact on costs and resources required for operations, but they strongly believe that computers can contribute to other aspects of operations such as speed and ease of performance. In other words, impacts have been strongest in augmenting existing operations; not in reducing the costs of those operations. Chief executives also indicated an overwhelming belief that computers will become more essential to the operations of government in the future.

Impacts on Decision Making by Top Executives

Results of the chief executive survey show a generally positive impact of computers on decision making (Figure 17). Strong majorities of the chief executives felt that computers provide both themselves and their department heads with assistance, either in the form of information that was not available before, or in providing helpful information for decisions. Relatively few of the chief executives believed that the reports produced by computers were too detailed for their use.

Figure 16. U.S. CITY AND COUNTY CHIEF EXECUTIVE VIEWS TOWARD COMPUTER IMPACTS ON GOVERNMENTAL PRODUCTIVITY

	% of Chief Executives Indicating:				
Productivity Impacts	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
For the most part, computers have NOT reduced costs of government operations where applied (N = 563)	9	42	17	29	3
Computers usually enable a reduction in the staff necessary to perform a task (N = 565)	4	28	25	39	5
For the most part, computers have clearly increased speed and ease of performance of operations	23	60	13	4	0
In the future, the computer will become much more essential in the day-to-day operations of this government (N = 564)	56	39	4	1	0

Figure 17. U.S. CITY AND COUNTY CHIEF EXECUTIVES VIEWS TOWARD COMPUTER IMPACTS ON DECISION-MAKING

	% of Chief Executives Indicating:				
Decision-Making Impacts	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
The computer makes information available to department heads that was not available before (N = 562)	37	54	5	4	0
Reports and other materials produced by the computer are too detailed for my use (N = 561)[a]	2	18	16	58	7
In general, computers provide information which is helpful to me in making decisions (N = 562)	28	59	6	6	0

[a]Disagreement to this question indicates a positive view towards the impacts of computers.

Impacts on the Work Environment of Government Employees

A large number of predictions have been made about the impact computers will have on work environments within organizations. Three of these--impacts on cooperation among departments, demands for accuracy in dealing with information, and impacts on supervisor-subordinate relations--were addressed in the chief executive survey. Chief executives are ambiguous in their feelings about the impact of computers on increasing cooperation among departments and agencies (Figure 18). Although a plurality of the executives believe computers have increased such cooperation, a large segment do not or are undecided. There is much stronger agreement that computers have increased demands for accuracy on employees who handle data, an observation that was anticipated. However, Figure 19 indicates that computers have had less impact than anticipated on the relationships between supervisors and subordinates. A strong majority of the chief executives (70%) believe that computers have had no impact on this issue whatsoever. Nevertheless, among those who do believe there has been an impact, there is a strong belief that computers have increased supervisors' control over their subordinates.

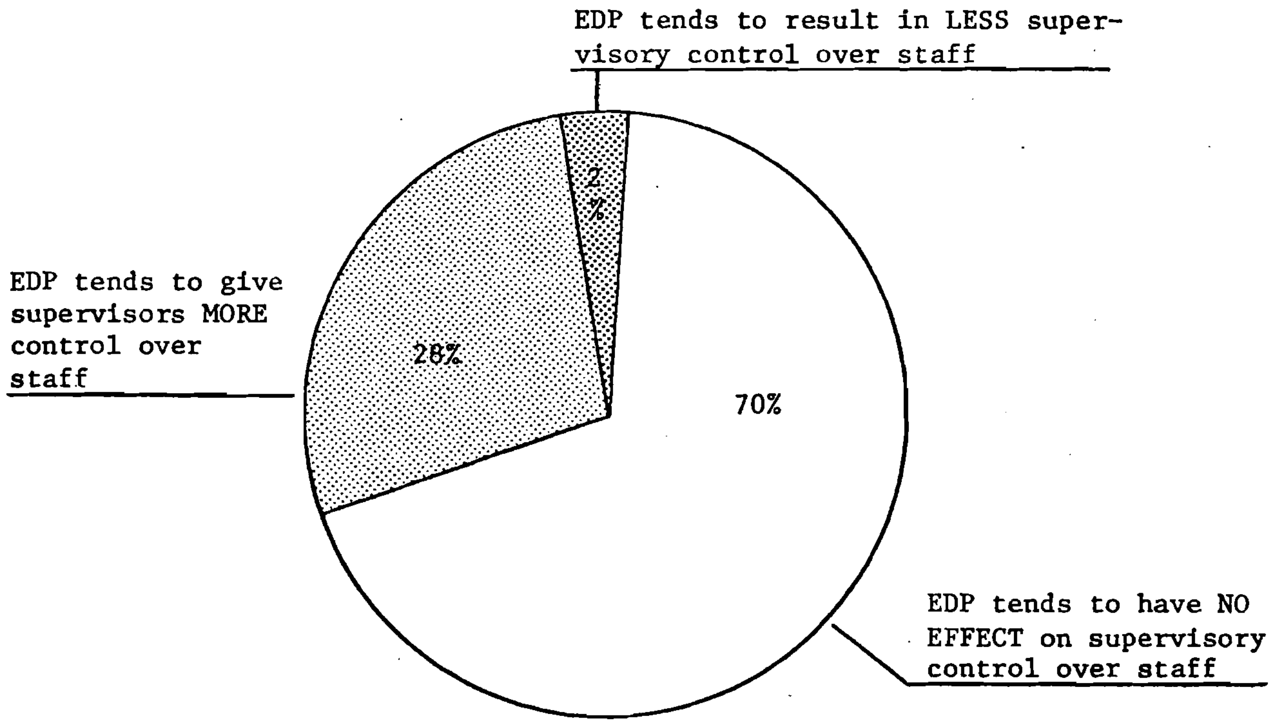
Impacts on Planning Local Futures

The final impact topic, planning local futures, has been one of the most talked about in literature related to both planning and computers. During the 1960's there was optimism that computers would help "solve urban problems" through use of models and simulations that would predict outcomes and allow comparison of development alternatives. These optimistic hopes have not been fulfilled. Very few computerized large-scale

Figure 18. U.S. CITY AND COUNTY CHIEF EXECUTIVES' VIEWS TOWARD COMPUTER IMPACTS ON THE LOCAL GOVERNMENT WORK ENVIRONMENT

	Percentage Indicating:				
	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Cooperation among Depts. "The use of computers and data processing results in greater cooperation among the operating departments and agencies" (N = 564)	6	43	37	14	1
Demands for Accuracy "The use of computers places increased demands for consistency and accuracy upon government employees in handling data" (N = 564)	22	65	10	3	0

Figure 19. U.S. CITY AND COUNTY CHIEF EXECUTIVES BELIEFS ABOUT THE IMPACTS OF COMPUTERS ON SUPERVISION OF SUBORDINATES



urban models are operational today; those that exist are seldom used [1,24,31]. One can find examples of small, simpler models such as Lowry's "metropolis" and some population models, but the large transportation, land use, housing and economic models are practically extinct as far as actual planning use is concerned. This is a curious finding, given their early popularity and the large number of such models built. Apparently they were judged worth less than the resources they required to operate and maintain them.

Computers have had a different kind of impact on planning, however, in the form of two major developments in the area of mid-range planning (2-5 years). The first of these is construction of urban data bases, which include population and demographic data, location and other geographic characteristics, land use and housing data, and similar environmental features. These data bases are frequently used to develop social indicators and to provide input to planning processes involving specific questions, such as the likely impact of new subdivision development on local schools. The second use of computerized assistance in planning is in application of models to optimize use of local government resources. The best examples of these models are those used in routing government service vehicles such as sanitation trucks, allocating police officers to patrol beats, and determining location of new municipal facilities such as fire stations. The current use of these two kinds of planning assistance far exceeds the current use of large-scale modeling and simulations.

What is the future of urban modeling and simulation efforts? It is possible that early disappointments with large-scale modeling were the result of a poor understanding of where and how computers can assist the long-range planning effort. Perhaps further experience with use of automation in planning will provide new insights into how such assistance can be developed. Also, the creation of urban data bases may eventually provide refined data inputs for the modeling efforts. But, the real difficulty to be overcome, at least in the United States, is resolution of the question of what kind of role the outcomes of urban models and simulations will play in a planning process that is by its nature highly political. Until such modeling and simulation efforts become highly reliable predictors of outcomes, they will be regarded simply as tools to generate support for one advocacy group or another.

In summarizing the impacts section of this paper, it is necessary to step back and take a broader look at what the responses to impacts in the foregoing six topical areas show. In general, there is a great deal of support and enthusiasm for computing in urban settings, and there is agreement that computers will become much more important to urban government in the future. But many of the anticipated impacts of computers have not materialized. This is particularly true with respect to predictions about the impact of computers on government productivity and on planning for local futures and to a lesser extent elsewhere. This observation about the marginal impacts of computing is clouded in most persons' experience by the fact that nearly everyone can cite examples of specific computer applications that have had substantial and impressive impact on a local government. In maintaining the proper perspective on the real state of impacts, however, it is important to realize that nearly every local government has one or two exceptionally good examples of useful computer applications. But, the great majority of applications will likely be unimpressive. Thus, examples of exceptional applications are spread widely but very thinly over the population of local governments.

In time this condition will probably change as more local governments adopt the technology and the more advanced governments begin to move their knowledge out to other governments. The continued decrease in cost for computer mainframes of considerable power will serve to expand use of the technology. And, the pool of knowledgeable people required to develop applications in the area of urban information systems, which has been smaller than the demand, will grow. Eventually, it is probable that the impacts of computers will extend out to citizens directly.

Problems with Computer Technology

This section of the paper will consider the profiles of use and impact presented above along with additional information to analyze problems with computer technology. This task is particularly important, since it is in analysis of problems in the context of use and impact that the sharpest perceptions about the state of technology use can be formulated. Also, the study of problems in use of technology can provide valuable direction on how technology should be developed in the future. It is widely recognized that systems concepts, however elegant in theory, are subject to a wide array of organizational, social, and political constraints when they are applied to an actual problem. Thus, there are organizational, social, and political problems that arise from application of systems concepts and technologies, just as there are benefits. Understanding of these problems refines understanding of the roles that applied systems concepts and technology actually play in organizational and social settings, and therefore provides a foundation for resolution of impediments to successful and beneficial application.

This section on problems with computer technology will deal with four classes of problems: expanding use of the technology; maintaining stability in data processing operations; managing the computer technologists; and sharing the technology.

Expanding the Uses of Computer Technology

Finding ways to expand the use of computer technology within a particular government frequently is considered a problem among local officials. Clearly, introducing the technology is difficult and requires some promotion, but this is the case primarily in new installations. Most installations in U.S. local governments have been using the technology for quite some time, and the technology is established. Interestingly enough, among some of the larger and more established data processing operations, there is an increasing desire to retard rather than promote expansion. Apparently user departments have become so enamored with the technology and its capabilities (both realistic and mythological) that the demand for service exceeds the supply. In these cases the data processing management faces dissatisfaction from users who feel that their needs are not being adequately met.

Figure 20 shows several indicators of the pressure towards expansion of applications. The current average number of applications operational in all local governments is 29. Six applications, on the average, are in development currently. Yet within the next two years the average number of applications planned for development is 23. Thus, most local governments are planning to double their number of operational applications within two years. Of course, many of these "planned applications" are optimistic dreams that will not be completed within two years, if at all. Nevertheless, these numbers show a strong expansionist tendency in data processing in U.S. local governments. Given the ambiguous impacts of the technology thus far, this expansionist perspective seems out of place. Instead of moving ahead categorically with application development--always asking "what application should be developed next?"--it might be wise for local governments to begin asking whether anything should be done next. A short suspension of development activities might allow time for the benefits and problems with existing applications and operations to come clear.

Maintaining Stability in Data Processing Operations

"Stability" in data processing operations is a term that describes the frequency of major changes in the data processing environment over a relatively short period of time. Figure 21 provides a breakdown of major changes reported by data processing managers to have taken place in U.S. local government computing installations over a period of two years. The extent of changes are comparable between cities and counties, but taken together the changes show a high degree of instability over the past two-year period; that is, a large number of major changes. Most installations have changed the size of their central processor (usually upward), and

Figure 20. U.S. CITY AND COUNTY EXPANSION OF COMPUTER APPLICATIONS

	Average for U.S. Cities and Counties
Applications in Development	6
Applications Planned for Development over Next Two Years	23
Applications Currently Operational	29

approximately one-third of the governments have experienced major changes in development priorities, generation of their computers, and/or top data processing management. One-fifth to one-quarter have changed the physical location of their installation and/or the organizational status of the data processing operation. A surprisingly high 17 percent of the cities and 15 percent of the counties have changed their mainframe vendor--a truly major change in operations.

The important thing about such changes is that each has a multiplier effect. Changes in hardware bring changes in software. Changes in organization bring changes in management and sometimes changes in development priorities. And many governments have experienced three or more such major changes within the past two years. Changes of this kind can bring tremendous added costs to the data processing function, whether they are planned or unplanned. Well planned and managed changes, such as a move to a new vendor may be, can usually keep costs to a minimum, but costs might still be quite high due to need for conversion, retraining, re-programming, and disruption during changeover. Moreover, many changes appear to be *unplanned*. Figure 21 also shows the data processing managers' perceptions of "planned" changes in the data processing environment over the next two years. The most striking feature of the comparison between "past" and "planned" changes is their *dissimilarity*. Using the past as the best predictor of the future, the estimate of planned changes seems overly optimistic. Overall, Figure 15 predicts that the near-term future changes will be only one-half those in the past. This is extremely unlikely.

Figure 21. PERCENT OF U.S. CITIES AND COUNTIES NOW MAKING OR PLANNING A CHANGE IN COMPUTING ARRANGEMENTS

	Percent of governments indicating a change:								
	CPU size	Development priorities	Generation of machine	EDP management	Physical location	Department status	Mainframe vendor	Installation relations	Number CPU's
Cities									
Change over last two years	57	42	40	31	21	22	17	12	10
Change planned over next two years	...	24	17	6	14	11	8	7	8
Counties									
Change over last two years	64	64	38	31	26	23	15	13	8
Change planned over next two years	...	25	18	4	23	13	4	11	7

Leaders (...) indicate not reported

Instability in the computing environment will probably exist for some time to come, and may even increase in some categories as new technological developments emerge. The costs of this instability are rarely reflected in budgets because they are unanticipated, but it is certain that they erode the benefits the technology brings. Also, many costly changes are correlated with attempts to improve service, such as buying a larger computer, so the benefits of the change might be diminished by its negative consequences. There is a great need for better understanding of these changes, with a goal of improving ways of planning for change and reducing the costs of change.

Managing the Computer Technologists

Problems with managing the technology take two forms: problems in managing the actual physical technology, much like asset management; and problems in managing the technologists who deal with the technology. It is commonly asserted that top managers must be involved in major decisions related to data processing. This is probably true, and some research has been done which correlates successful data processing proceeds without the direction of top management. The URBIS data indicate that without top management direction data processing becomes largely "uncontrolled," and in some cases might be "out of control."

Figure 22 shows the distribution of individuals typically involved in a range of important data processing decisions. The data indicate that top managers (the chief executives and local legislatures), with the predictable exception of involvement in major reorganization decisions, are involved primarily in the narrowest of major decisions--procurement of computing equipment. Even then they frequently only pass judgment on the recommendations of the government staff. The involvement of these top managers in such decisions is understandable, given the financial significance and visibility of equipment procurement decisions. But, it is the decisions about development of the data processing activity and its applications that really shape data processing's impact on the government. Yet, these important development decisions appear to be made primarily by the data processing department head and user department personnel (Figure 22). It is probable that the data processing department dominates these decisions since data processing has a monopoly on technical knowledge needed to fully evaluate a proposed application (and thus can easily find reasons why a given project should or should not be undertaken), and because data processing can "retaliate" against recalcitrant user departments by providing consistently substandard service.

Failure of top management to control the data processing function can have serious consequences. Data processing operations in most organizations are supposed to function as service providers. However, when top management fails to insure that the data processing operation provides adequate service to user and management needs, the operation can become insulated and not accountable to either management or users. When this happens, the data processing operation can become a "skill-bureaucracy"--a self-serving department that dominates its domain through a monopoly of expertise and technical resources.[7] A skill bureaucracy in this sense seeks to maintain freedom from both managerial and user control, to expand its activities, to dominate its relations with users, and operate by its own standards of professionalism [3,27].

Figure 22. U.S. CITY AND COUNTY DATA PROCESSING MANAGERS' PERCEPTIONS OF CONTROL POINTS OVER DECISIONS REGARDING COMPUTERS AND DATA PROCESSING[a]

Questionnaire Items:	Percentage Indicating: Chief executive official	Data processing	Dept. head over data processing	User dept.	Local legislature	Inter-dept. board	Inter-governmental board	Other	Total N
"Provide a major input into whether of not a new set of EDP applications will be adopted."[b]	33%	78	NA	73	15	32	NA	NA	(477)
"Has authority for setting priorities for the development of new applications."[c]	18%	25	26	3	3	15	5	5	(477)
"Must approve budget requests for new computer mainframes and systems."[b]	65%	60	55	6	72	13	10	11	(477)
"Must approve requests for new peripheral equipment in user departments."[b]	57%	65	48	41	52	10	7	9	(475)
"Is primarily responsible for evaluating services provided by this (data processing) installation."[c]	12%	30	23	21	3	7	4	2	(475)
"Must approve major reorganizations such as changing the departmental status or location of EDP, or consolidating several independent EDP units."[b]	69%	44	46	6	53	9	9	7	(475)

[a] The following questions were asked of city and county data processing managers.

[b] Respondents indicated all categories which apply, therefore, the percentages across will add to more than 100%.

[c] Respondents were asked to indicate the one best answer.

The data from the URBIS Project indicate that many data processing units in the U.S. tend toward a skill bureaucracy. This tendency can be seen in three features. First, the data processing managers see as their greatest problems shortcomings of users and lack of sufficient resources for the data processing operation (Figure 23). Contrarily, the problems given the lowest measure of concern are inadequacies of the data processing staff. Going by the rank ordering in Figure 23, out of 27 problems listed, the inadequacies of users appear as problems #1, 2, 7, 8, 14, 15 and 16. Shortages of data processing resources appear as numbers 6, 9, 11, 12, 21 and 25. Problems related to the performance of the data processing function, on the other hand, are ranked as numbers 13, 17, 18, 19, 22 and 26. Interestingly, based on URBIS Project fieldwork the most common problems for users are delays in operating schedules and poor performance of computer hardware, which rank as numbers 19 and 22 according to the data processing managers. These figures suggest that data processing managers tend to view major problems as originating from other units, not from their own. This perspective, coupled with the low ranking of problems considered important by users, suggests that a service orientation might be lacking in many installations.

The second illustration of the tendency towards a skill bureaucracy is evidence of expansionism in data processing departments. Figure 24 presents data on recent changes in data processing operations among the local governments surveyed. These data offer several indicators of expansion in data processing operations: 80 percent of the installations have increased or plan to increase CPU size within the next year, 59 percent

Figure 23. U.S. CITY AND COUNTY DATA PROCESSING MANAGERS' PERCEPTIONS OF PROBLEMS[a]

Rank	Problem	Value[b]
1	Users not knowledgeable about EDP	1.54
2	Users underestimate time for development	1.48
3	Large number of old programs to convert	1.30
4	Inadequate documentation for users	1.15
5	Inadequate documentation for operating staff	1.14
6	Too few analysts	1.12
7	Inaccuracy of data supplied to EDP	1.09
8	Users' expectations unrealistically high	1.08
9	Too few applications programmers	1.08
10	Inadequate documentation for maintenance	1.07
11	Difficulty recruiting good EDP staff	.95
12	EDP salaries not competitive within industry	.90
13	Application development time exceeds delivery dates	.89
14	EDP lacks acceptance of department heads	.80
15	EDP lacks acceptance of user department staff	.76
16	EDP lacks acceptance of local officials	.76
17	Frequent minor software problems	.75
18	Programs do not meet user specification	.72
19	Operational schedules delayed beyond deadlines	.72
20	High costs modifying programs to meet requests	.66
21	Cuts in EDP design and development budget	.51
22	Unreliable performance of comp. hardware	.47
23	EDP cost too high for local officials	.43
24	High cost of training EDP staffs	.43
25	Cuts in EDP operations budget	.40
26	Unreliable performance of operating system	.39
27	High costs to train users to use EDP applications	.38

[a] N = 495

[b] Average score based on the following values for categories:
2 = Now working on this problem
1 = Was a problem but has been well resolved (in last two years)
0 = No problem in last two years

have changed or plan to change generation of machine in the next year; and the average number of applications under development or planned within the next two years is nearly (96.9%) equal to the number now operational.

Similarly, Figure 25 indicates that the distribution of programmer and analyst time spent on various activities is weighted toward working on new applications (22% in design of new applications plus 25% in programming and debugging new applications equals 47%), while a much smaller segment of time is devoted to improving existing operations (11% for reconceptualizing old designs, plus 19% maintaining existing programs equals 30%). Moreover, the managers feel that these areas of new development effort should be increased in the future relative to working with existing applications.[8]

The third feature of the tendency towards a skill bureaucracy is weak control over data processing by management and users. This feature is particularly important in interpreting these data as indicators of skill bureaucracy. With only the evidence of the data processing managers' perceptions of problems and the expansionist behavior of data processing organizations an alternative theory could be developed. In brief, one might argue that it is high user demand for services that creates the managers' perceptions of problems with users, the concern about expanding resources for data processing, and the emphasis on development of new applications. The managers, this argument might claim, are merely trying in good faith to satisfy great and sometimes excessive demand with limited resources. This argument would be persuasive if

Figure 24. U.S. CITY AND COUNTY RECENT CHANGES IN COMPUTING OPERATIONS

Change	Value
Recent major increase in CPU core size	62% of governments
Major increase in CPU core size planned in next year	18% of governments
Recent change of machine generation	41% of governments
Change of machine generation planned in next year	18% of governments
Average number of automated applications currently under development	6.0 applications
Average number of automated applications planned within next two years	23.1 applications
Average unmber of currently operationsl automated applications	29.2 applications
Applications under development or planned as a percentage of currently operational applications	96.9%

users had a major influence on important data processing decisions. However, the data in Figure 22 (shown earlier) indicates that the data processing department has primary influence in all but two important decisions--reorganization of the data processing function and procurement of new mainframes. And, those two decisions have little to do with day-to-day delivery of services to users. In all other decisions, data processing has primary influence and could easily dominate the relationship--for example with user departments over development of new applications. It must be remembered also that Figure 22 presents the data processing manager's beliefs about who is involved in decisions. These managers might feel that users have more input to application decisions than the users feel they do.

What are the implications of this skill bureaucracy tendency? On the one hand it might be argued that the impact is minor in the sense that users are receiving at least a measure of the service they might be receiving if they had better control over data processing. It might even be the case that users are now fairly satisfied with the service, as a result of persuasion by data processing that the users are receiving good service given the "technical" constraints understood only by the computer professionals. There is the danger, however, that a skill bureaucracy causes greater problems by making the needs and objectives of top management and users secondary to its own. This can result in several common occurrences in local governments:

1. Applications will be technically sophisticated and refined, but not particularly useful to top managers or users.

Figure 25. U.S. CITY AND COUNTY ALLOCATION OF PROGRAMMER AND ANALYST STAFF TIME IN COMPUTING INSTALLATIONS

Activities	Mean % of over all programming & system analyst time	Area in need of increased activity
Analysis and design of new programs	22%	45%
Programming and debugging of new applications programs	25%	10%
Reconceptualization designs of old applications	11%	14%
Maintaining applications programs	19%	1%
Maintaining-operating system software	9%	1%
Documentation	8%	25%
Other	6%	3%

2. Hardware has excess capacity and sophistication (and thus great resource requirements) relative to services provided to users and top management.
3. A propensity to move ahead in automating new applications without a clear expectation of benefits.
4. A dependency of top management on the data processing department for critical information needed to determine development priorities, thus giving data processing an exceptionally strong influence on setting of those priorities.

While these problems seldom threaten the functions of local governments in a major way, they indicate less than optimal use of computing resources in the interests of urban planning and management--which in itself is a serious concern.

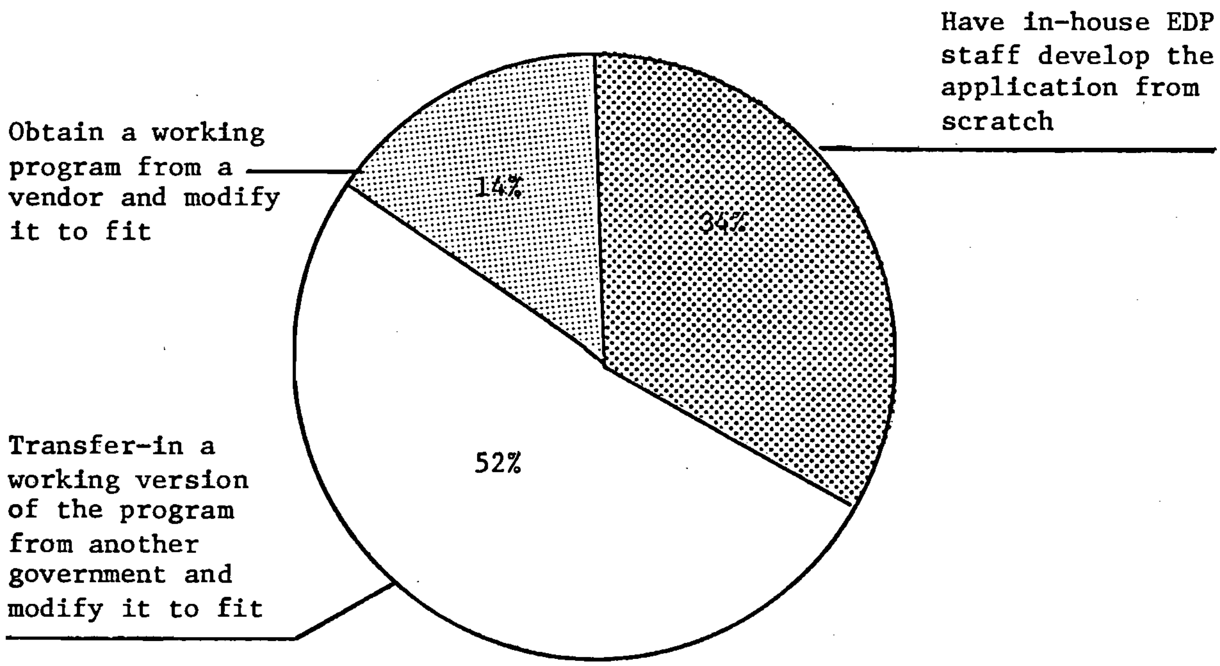
Sharing Computing Technology

The final problem area to be discussed in this section relates to sharing of computing technology. This subject can be understood more readily in the context of the concept of "technology transfer."[9] Technology transfer refers to the moving of technology from the place it was developed to another place where it is needed. This notion, which is very much in vogue these days, is based on several tenets: that transfer saves tremendous costs for the transferee; that transfer is an easy and simple task; that transfer allows establishment of sophisticated technologies in unsophisticated locations much more quickly than if the technologies were developed locally. These tenets of transfer all have strong intuitive appeal, and if true, indicate that technology transfer is the key to a great many problems of expanding the use of, and therefore the benefits of, technology. Unfortunately, the benefits and costs of transfer come together in a complex environment, and there is evidence that many transfer projects have a low net benefit.

Transfer in the context of information systems most often refers to transfer of computer applications from site to site. The URBIS Project data on transfer of applications indicate complexity and ambiguity in outcomes. Generally, there is great support among chief executives in local governments for the concept of transfer (Figure 26). More than half believe that it is best to transfer applications from other local governments, and another 14 percent believe it is best to transfer (buy) programs from vendors. But despite this strong preference for transfer, comparatively few governments actually transferred applications.

Figure 27 presents statistics on transfer in U.S. cities and counties. These data show only 22 percent of cities and counties have transferred applications into their governments in the last two years, and only 23 percent plan to transfer-in applications during the next two years. The overlap between those that have transferred and those that plan transfers is about 66 percent. Also, Figure 27 indicates that the average number of applications transferred-in among governments that have transferred is low--only 1.5. Both the incidence of transfer among governments and the number of applications transferred is lower than would be expected based on the supporting arguments for transfer.

Figure 26. U.S. CITY AND COUNTY CHIEF EXECUTIVES' PERCEPTIONS ON DEVELOPMENT vs. TRANSFER OF COMPUTER APPLICATIONS



Note: Only applies to those governments now using computers.

Figure 27. U.S. CITY AND COUNTY ACTUAL AND PLANNED TRANSFER OF APPLICATIONS

	Have transferred in last 2 yrs.	Plan to transfer in next 2 yrs.
CITIES		
Percent of governments	18%	22%
Average number of applications	1.4	1.5
COUNTIES		
Percent of governments	29%	25%
Average number of applications	1.6	1 9
TOTAL, ALL CITIES AND COUNTIES		
Percent of governments	22%	23%
Average number of applications	1.5	1.7

It is also interesting to look at the kinds of applications that are being transferred. Figure 28 presents a breakdown of all applications that have been transferred more than three times. This list represents over two-thirds (115) of the 149 transfers recorded in the data. Many of the applications recorded here are simple, stand alone batch applications in "bread and butter" functional areas such as budgeting and revenue, accounting, courts (docketing and scheduling), welfare (payments and records), voter registration, and central garage (scheduling and maintenance records). The others (police, geoprocessing, and transportation), are areas in which there may be sophisticated applications, but they are also areas in which the federal government has extensively promoted and supported development and transfer efforts. Thus, of the few applications that do get transferred among local governments, the majority are either simple and unsophisticated applications, or are products of external support from federal assistance programs.

The final difficulty in the transfer argument is demonstrated in Figure 29. This table indicates the comparison between the state of development in cities that have transferred applications and those that have not. Although this table shows only data for cities, the data for counties are comparable. These data show that the greatest number of transfers occur in the most sophisticated sites--those with the largest average data processing expenditures, the largest computers, the largest number of applications, the most applications on-line, and the highest level of documentation. This contradicts the claim that transfer moves technology from more sophisticated to less sophisticated sites. Instead,

Figure 28. U.S. CITY AND COUNTY APPLICATIONS TRANSFERRED BY FUNCTIONAL AREA[a]

Area	Number Transferred
Budget and Revenue	24
Accounting	23
Courts	19
Police	15
Welfare	12
Voter Registration	6
Geoprocessing	6
Motor Pool - Central Garage	5
Transportation	5
All others	Less than 5 applications each

[a]This shows only those functional areas in which there were five or more applications transferred. Applications listed here equal 115 out of a total of 149 applications transferred.

it appears that transfer is most common *among* sophisticated sites. The less sophisticated sites do little transfer.

Given the potential to applications transfer, one may ask: Why hasn't transfer flourished? Although the transfer concept is sound in general principles, it falls down by ignoring critical realities about the conditions of local government computing. There are two major aspects of transfer that its promoters often overlook. First, transfers are not always easy and they do not necessarily save money. In fact, transfers are often difficult and expensive to effect. There are several reasons for this. The most common is that applications developed at one site are often not suitable to the local needs of another site. This is particularly true with applications developed by the federal government to serve federal purposes, but which must be implemented locally. The local government bears a cost and gets relatively little benefit. Another problem is differences in hardware and software between transfer sites. Overcoming incompatibility problems is sometimes a costly and frustrating task. Applications designed to work within the context of one site's operation may not fit another site's standard operations, causing problems with users. Yet another difficulty is lack of sufficient documentation--a problem that makes evaluation of a potential transfer application almost impossible. Finally, there is less enthusiasm among the local data processing personnel for transferring-in an application than there is for developing one in-house, since in-house development allows more creativity and a sense of accomplishment. All these factors can drastically inhibit the ease and benefit of transfer,

Figure 29. COMPARATIVE STATE OF EDP DEVELOPMENT AMONG U.S. CITIES THAT HAVE TRANSFERRED APPLICATIONS

Indicators of EDP Development Status	Transfer Sites	All URBIS Cities
Average EDP expenditures	$948,384	$572,210
Average EDP expenditures as a percent of total operating budget	1.6%	1.0%
Average total core capacity in bytes	515K	165K
Average total operational applications	39	28
Average total operational applications on-line	12	6
Average total operational applications with documentation	25	16

A second aspect of transfer often overlooked is that there is benefit in "re-inventing the wheel" for the local government. There are very important benefits for local governments in doing in-house development, despite higher initial costs. The application is tailored from the start to fit the particular circumstances it must operate in, and, perhaps more importantly, the local government staff learns in detail about the application as it is built. The learning benefits of in-house development become especially important later on, when it is time to maintain or modify the application.

Why are these observations about transfer so important? Primarily because they contradict the premises behind the popular transfer arguments. Since the transfer concept is so alluring at first glance, and since the majority of chief executives believe that transfer is the preferred method of acquiring applications, it is necessary that the facts about actual transfer experience temper what may be unwarranted enthusiasm for the concept. More important, however, is the fact that further study into the problems of transfer may reveal solutions that enable transfers to take place more successfully and widely. This would allow local governments to capitalize on the proclaimed benefits of transfer, which, if attainable, are certainly worth achieving.

SUMMARY OF STATE-OF-THE-ART

Taken together, the foregoing characterizations of local government computing suggest several summary comments on state-of-the-art. It is clear that use of information technology in local governments is quite extensive, although this use is not particularly sophisticated in most sites. Those governments that do make extensive and sophisticated use of the technology are typically the larger governments. Smaller governments appear to be "catching up" to the state-of-the-art in larger governments.

Regardless of the state-of-the-art of computing in any local government, all governments face certain problems with the technology. Those problems discussed in this paper relate to expanding use of the technology, maintaining stability in data processing operations, managing the technologists, and sharing the technology. These are only illustrative of the range of problems local governments face; there are other problems of equal seriousness not discussed here, such as finding appropriate organizational configurations for computing departments, improving procurement procedures for acquiring computing capability, and developing standards in hardware and software configurations to facilitate comparison and transfer.

The problems facing local governments in using the technology are probably responsible for the ambiguous impacts of the technology on local governments. It is fair to say that the benefits from computing technology are less spectacular than many predicted, but they are nonetheless present. Usually the benefits take the form of small, incremental improvements in operations and decision making. Taken as a whole, these small improvements probably represent a major step forward. Nevertheless, nearly all agree that there is much difficulty to overcome before computing will bring the beneficial impacts people believe it can.

IV. A POSSIBLE IIASA ROLE IN STUDY OF URBAN INFORMATION SYSTEMS

On an international level, there is a need for further cooperation and exchange in the area of urban information systems. Some such exchange has taken place through a variety of channels over the past ten years, particularly through the efforts of such groups as the Organization for Economic Cooperation and Development, the International Bureau for Informatics, and Data for Development. Other, smaller projects have encouraged cooperation between individual nations. Still, there is a need for more extensive and continuing cooperative work on the international level. IIASA could play an important role by virtue of its strong position as a central information exchange that is both affiliated with all the industrialized nations and concerned for the developing countries.

As this paper indicates, there has been much expansion in use of urban information systems within the United States in the past 15 years. According to information presented at the recent OECD international seminar on "Information Technology in Local Government" (November 1976, Paris), the rapid growth of urban information systems exhibited by the United States is also occurring in other OECD member nations. Similar growth and interest is present in the Soviet Union, as evidenced by the recent Soviet-U.S. exchange program on the Application of Computing to the Management of Large Cities. IIASA could perform a valuable role in serving as a center for study and exchange in this area.

Several useful projects could be undertaken in the near future by such a center. First, it would be worthwhile to collate the findings of the current and recent studies of urban information systems at a single source, and to integrate the findings of these studies in a comprehensive worldwide overview of the field. This would be a source of information for all nations, and would provide a benchmark against which international progress in this field could be judged. Second, comparative analysis of approaches to use of urban information systems could be done to point out the viability of different strategies for use of the technology in different conditions. This comparison would yield examples of applications that have universal applicability, thus creating a source for information about the various methods of applying computing technology to urban problems. Finally, the center could publish a useful handbook of urban information systems that would describe the applications of computing in urban areas. All these publications would provide useful education and advice for developed and developing countries alike.

More broadly, there are three areas in which IIASA can establish ongoing study. The first of these is a continued statistical portrayal of the state-of-the-art in urban information systems, based on data from periodical studies performed in various countries. The second of these is a continuing review of "generic applications"--applications that have international applicability. Examples of such applications might be:

1. Sophisticated analytics: population, land use, revenue and other forecasting models.
2. Information and referral: health, education, social services, recreation, and other information services for governmental and public uses.
3. Geoprocessing: use of geographic data in planning, housing, renewal, public works, and so on.

4. Process control: traffic control through automated signals, water and utility distribution and control, dispatching systems.
5. Reservation systems: transportation reservations, recreation and cultural events.
6. Resoure control: inventory control, vehicle fleet management maintenance, scheduling, manpower allocation, cash management, budget monitoring.
7. Facility location: optimal location of fire stations, hospitals, parks and recreational facilities.

The third area of ongoing study is into processes for managing information technology. The need is particularly great for study into problems associated with introduction and development of the technology, development of data bases and operations, organization of the data processing function, and training of personnel for the data processing operation.

In order to carry out such ongoing such, it would be advisable for IIASA to establish, in-house, one or two international experts in the urban information field for a period of two or three years. These individuals could develop a program of study and publication, based on contributions by a wide range of international experts. These other experts might contribute through several channels: international conferences built around solicited papers; specific study projects in different countries; short-term visits (6 months to a year) to IIASA headquarters to work on projects. Other mechanisms for involving international experts are available and might be tried as well. A dedication to furthering the understanding and beneficial use of information technology in urban settings is, of course, a prerequisite for such ongoing study. Given such a dedication, it is likely that IIASA could perform a major positive role in advancing the field of urban information systems on a worldwide basis.

V. CONCLUSION

This paper has presented an analytical overview of urban information systems in the United States from the standpoint of the extent of use, the impacts of the systems, and the problems with the systems. The data presented reveal extensive use of the technology, with ambiguous impacts and frequently difficult problems. It is likely that these findings are consonant with the situaiton of other urban information systems around the world. It is hoped that better understanding of all three facets of urban information systems--use, impacts, and problems--will provide answers to improved application of the technology toward solving the serious problems facing urban centers in both the United States and the rest of the world. IIASA, given sufficient interest in and dedication to the study of urban information systems, might provide an international center for expertise and information exchange on this important subject.

NOTES

1. The findings presented here about the use, impact and problems of computers in local government are the result of joint work by the authors and other members of the URBIS Research Group, particularly James N. Danziger, William H. Dutton, Rob Kling, Joseph R. Matthews, Alexander Mood, Alana Northrop, and David G. Schetter. However, the descriptions and conclusions about the present status of urban information systems are the opinions of the authors. Tbey should not be ascribed as opinions of the other members of the URBIS Research Group, or of the National Science Foundation which has supported this research through a grant for the URBIS Project.
2. See [30, 34, 39, 40, 41, 42, 43, 44] for other discussions related to the study of technology and its impacts.
3. The URBIS Project is a multi-year, nationwide study formally titled "An Evaluation of Information Technology in Local Government." Detailed description of the project can be found in [22]. A complete explanation of the empirical research design being used in the study can be found in [8]. Similar study has recently been completed by a panel of the Organization for Economic Cooperation and Development involving nine member nations of the OECD. The URBIS Project has served as the United States input to that panel's study [5]. Projects similar to the URBIS project in design are now being planned in several countries, including Great Britain, Germany and France. For further information on the work of the OECD in this field, see [11, 25 and 35].

4. A data element is the response of one individual (or local government) to one questionnaire item.

5. The information presented is taken primarily from [15, 20 and 29].

6. See [28 and 33] for more extensive discussion of these topics.

7. This discussion is taken primarily from Danziger [3].

8. Several categories from Figure 25--"maintaining operating software," "documentation," and "other"--are not used in this discussion and comparison because they are related to both "new" and "old" development.

9. This discussion is taken from Kraemer [15].

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