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AN ASSESSMENT OF COMPUTER TECHNOLOGY IN U.S. LOCAL GOVERNMENTS

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Abstract—This paper presents a broad, current assessment of the use and impacts of computers and electronic data processing in the larger municipal and county governments of the United States. It is based on extensive data gathered by a major research project which has involved both case-studies in forty cities and a large census survey of urban local governments in cities with greater than 50,000 population and counties with greater than 100,000 population. Three general themes are explored: (1) the current 'state-of-the-art' of computer technology in local government, including general profiles of the governments using EDP, the characteristic administrative arrangements for providing the EDP function, and the types of uses to which EDP has been applied; (2) the impact of computers on local governments, particularly in the areas of operational performance, coordination and control, and local planning; and (3) critical issues currently facing local government in the effective utilization of EDP, including development and management of computer technology, technology transfer and privacy protection.

INTRODUCTION

URBAN areas throughout the world are facing increasingly serious and complex problems. Among these problems are deterioration of inner cities, fiscal crises, increasing incidence of poverty and crime, transportation inadequacies, and air and water pollution. These problems are taxing the operational and planning capabilities of urban governments to the limit. In recent years, there has been hope that the application of information technology, particularly computers, to urban management might assist in solving these problems by improving the operations of government agencies and by providing improved data for management and planning [1, 2]. Indeed, the use of computers in urban administration has grown steadily since its introduction in the 1950's.

Despite this rapid growth in the utilization of electronic data processing (EDP) by local governments, extensive study of the impacts and outcomes of this technology has begun only recently. The lack of study has resulted in several interrelated problems. First, there has been little clear evidence that application of the technology has brought desired benefits. Second, there has been insufficient understanding of the causes behind 'successes' and 'failures' in achieving benefits from EDP use. Finally, there has been insufficient effort to generate a reliable set of recommendations that suggest how local governments might avoid problems and capitalize on the potential benefits of EDP technology.

This paper presents a broad, current perspective on a selected set of important topics relating to the use and impact of computers and EDP in the larger general purpose local governments in United States cities and counties. Three general themes are explored: (1) the current 'state-of-the-art' of EDP in local government, including general profiles of the governments using EDP, of the characteristic administrative arrangements for organizing the EDP function, and of the kinds of uses to which EDP has been applied; (2) the impact of EDP on local governments, particularly on operational performance, on coordination and control, and on local planning; and (3) some of the critical issues currently facing local government in the effective utilization of EDP, including recommendations for the management of EDP and an evaluation of technology transfer.

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This paper is primarily based on data gathered in a current research project which includes intensive case studies as well as a large census survey of general purpose local governments in U.S. cities with greater than 50,000 population and counties with greater than 100,000 population.† The paper attempts to synthesize research findings from this project and from other recent studies of EDP in local governments.

I. A GENERAL PROFILE OF COMPUTER UTILIZATION IN U.S. LOCAL GOVERNMENTS

Overview

Electronic computers were first introduced into U.S. local governments in the 1950's. Since that time, their utilization has grown continuously. Computers were first adopted by larger local governments and, over time, by medium and smaller governments for handling routine operations, particularly in the finance function (e.g. billing, payroll). Since the finance unit was usually the major user, the computing operation was often located in that department. As EDP applications have expanded into other local government functions, the computing operation has tended to move into an independent EDP department. Currently, most local government EDP usage remains in relatively straightforward information processing activities, but there are significant experiments with more sophisticated applications.

Political, economic and population profile of communities using EDP

Current use of EDP. In general, use of EDP is related to the size of the local government, as measured by population (Table 1). The larger the local government, the greater the likelihood of EDP use. Over one-half of all cities with more than 25,000 in population currently use EDP. And more than 90 per cent of the larger cities and counties (population greater than 100,000) use EDP.

Political and socio-economic characteristics of users. EDP has so extensively penetrated the larger local governments that it is difficult to generalize about the unique political and socio-economic characteristics of EDP users. It is possible, however, to characterize those local governments which have 'more developed' EDP [4]. 'More developed' EDP

Table 1. U.S. cities and counties using EDP

Classification	No. of governments* (A)	Governments using EDP No.	Governments using EDP % of A
Total, all cities	2294	1177	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	308	58
10,000–24,999	1356	488	36
Total, all counties	2221	557	25
Population group			
500,000 and over	58	56	97
250,000–499,999	70	68	97
100,000–249,999	182	164	90
50,000–99,999	330	85	26
25,000–49,999	568	78	14
10,000–24,999	1013	106	10

* 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.

† More complete discussion of the URBIS Project can be found in Kraemer and King [3]. Selected data for smaller cities (population between 10,000 and 50,000) and smaller counties (population between 10,000 and 100,000) are included in some tables. These data were gathered in a survey conducted by the International City Management Association. The data in this essay refer only to general purpose local governments and do not include school districts or other special district agencies.

is a relative measure based on a higher level of investment in EDP, an earlier adoption decision, a greater number of automated applications, and more sophisticated applications. The local governments with more developed EDP tend to be in environments with larger populations, larger proportions of higher socio-economic strata, and in the Western or Southern regions of the U.S. Internally, these governments are more likely to employ structures and practices associated with a professional management orientation to government (e.g. an appointed administrative officer and measurable program objectives). Interestingly, these governments have neither greater nor fewer financial resources than comparable governments with 'less developed' EDP.

Patterns of EDP adoption in local governments. Decisions by local governments to adopt EDP have increased continuously since introduction of the technology. The larger governments adopted the technology first, followed by governments in successively smaller population groups at lags of about 5 yr. Cities adopted the technology earlier and more rapidly than counties, leading the counties by about 5 yr overall. The 'take-off' period for most large cities began in the mid-fifties, for medium-sized cities in the late 1950's and for smaller cities in the early to mid-1960's. Both medium-sized and smaller cities experienced a rapid rate of adoption. The 'take-off' period for most large counties began in the early 1960's, for medium-sized counties in the mid-1960's and for small counties in the early 1970's. The rate of adoption in counties has been quite rapid in both the large and medium-sized counties, which appear to be overtaking the larger counties. The period of greatest overall growth among all governments has been since 1970. While the larger governments have required about 20 yr to adopt the technology fully, the medium-sized and smaller governments appear to be adopting the technology more rapidly. Local government adoption patterns approximate the logistic curve which often characterizes the diffusion of a technical innovation (Fig. 1). Thus, the data suggest that smaller governments will continue to adopt computing at a high rate until they approach the level where nearly all have adopted.

In part, these adoption patterns are a function of broader awareness of and acceptance of the utility of EDP for local government operations. In addition, the capabilities of the technology have expanded and the relative costs of hardware have decreased,

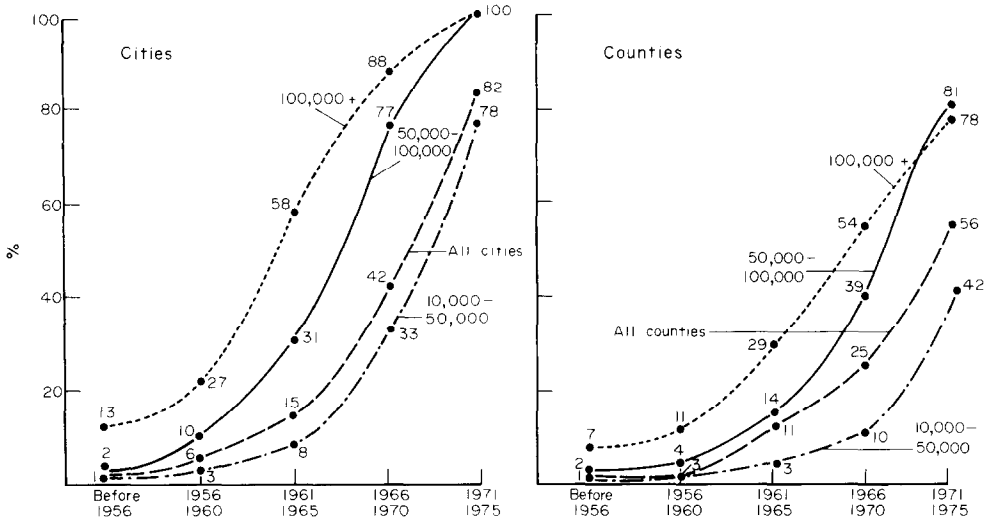

Fig. 1. Cumulative percentage of U.S. cities and counties utilizing computers, based upon only those governments indicating year of adoption, over all responding governments. N = 1063 cities and 400 counties.

[a]This estimate is based upon only those governments that responded and does not include those that were automated but did not answer. For cities over 50,000 and counties over 100,000, the number of governments using computers is based upon only cities and counties having in-house computers; cities and counties with service bureaus, regional installations or other outside sources were not included. For the smaller cities and counties, all sources of computing were included. Thus, the estimates tend to be low for the larger governments and high for the smaller governments.

making EDP adoption increasingly feasible and attractive, especially for smaller governments. The first and second generation computers of the late 1950's and early 1960's were characterized by expensive, large-scale batch-processing systems. By the mid-1960's, the extensive time-sharing capabilities and the more sophisticated peripherals of the third generation machines were prevalent. Advancements during the late 1960's and early 1970's included a relative reduction in cost, more sophisticated software such as data base management, sophisticated communications and teleprocessing systems, and the introduction of smaller, less expensive minicomputers.

Administrative profile of EDP use

Organizational arrangements for provision of EDP. There are several arrangements whereby local governments obtain computing capability: in-house computer operations, outside service bureaus, private management of a government-owned facility, or the inter-governmental sharing of a jointly-owned facility. Some governments use a combination of these arrangements; but two forms predominate, depending on the size of the local government.

Larger governments generally utilize a single, in-house, centralized installation (Table 2). Equipment is usually leased or rented rather than purchased. In most large governments, the computer operation is located in an independent EDP department. In some governments, another computer is operated by an individual user department. Applications tend to be developed in-house by analysts in either the EDP unit or user department; but other application sources are also used, including consultants, computer manufacturers, software vendors, and other public agencies.

In contrast, the governments below 50,000 population show a stronger tendency to procure computing from outside sources. Among those small local governments that do in-house computing, most have a single centralized computer. It is purchased rather than leased and is located in the finance or controller's department. However, smaller local governments (especially the smallest ones) make substantially greater use of outside sources for provision of EDP services. Usually these outside sources are service bureaus, although some governments utilize regional installations shared with other governments. Only one-fourth of the smaller local governments develop most automated applications in-house. Their applications tend to be designed by outside sources, primarily by manufacturers, consultants, and service bureaus.

Trends in EDP organization and management

(a) *Management orientation and user orientation.* Organization of EDP operations in local governments appears to be evolving to accommodate both greater management

Table 2. Percentage of U.S. cities and counties using various arrangements for data processing services, by population*

Classification	Total governments reporting (N)	Per cent of governments with: In-house data processing (%)	Facilities management organization (%)	Public regional installation (%)	Private service bureau (%)
Total, all cities	1089	72	0	14	41
Population group					
500,000 and over	20	95	0	10	15
250,000–499,999	27	93	0	22	11
100,000–249,999	79	90	4	8	11
50,000–99,999	180	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	562	59	1	12	33
Population group					
500,000 and over	39	87	5	15	8
250,000–499,999	53	87	5	6	11
100,000–249,999	100	69	2	20	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

* Total row percentages add to over 100% owing to some governments using multiple sources.

Table 3. Per cent of U.S. cities and counties now making or planning a change in EDP arrangements

	Per cent 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 2 years	57	42	40	31	21	22	17	12	10
Change planned over next yr	...	24	17	6	14	11	8	7	8
Counties									
Change over last 2 years	64	37	38	31	26	23	15	13	8
Change planned over next yr	...	25	18	4	14	13	4	11	7

Leaders (...) indicate not reported.

orientation and greater user orientation of computer services. Over the last decade, the trend has been to remove control of computer operations from the finance department and to institute a separate EDP department directly under the control of the chief appointed and/or elected official. Moreover, the number of EDP installations in operating departments also has increased markedly during this time. These structural changes can be interpreted as attempts to enhance the responsiveness of EDP services to non-finance users, particularly to the top managers' definition of the needs and priorities for EDP use and to their growing awareness of the potential of automated information systems as management tools.

(b) *Instability of EDP operations.* EDP operations in the larger U.S. local governments are characterized by a surprising level of instability (Table 3). In particular, there are frequent major changes in computer equipment. During the last 2 yr, over two-thirds of the local governments reported a change in generation of the computer mainframe, a change in the mainframe vendor, or a substantial change in the central processing unit core size. These hardware and equipment changes generate other changes, including conversion of existing programs, staff retraining, and modification of data collection procedures.

Other important sources of instability are changes in data processing management and frequent changes in development priorities for new applications. Many of these changes are unplanned and, apparently, unanticipated. Data processing managers report that they expect changes in most categories about as often as in the recent past, except with respect to the management of the computing operation (that is, their own job!). The present pattern seems the most reliable predictor, and thus it is likely that the current high level of instability will continue.†

The state of information technology

EDP resources

Although the proportion of local governments using EDP is high, the *level* of the EDP operation, when measured by the level of expenditure, staff size, and computer capacity, varies considerably among local governments. These measures of resources allocated to the EDP operation can be summarized briefly.‡

Expenditure. Local governments, on the average, spend about 1% of their total operating budgets on EDP, with larger governments spending a greater proportion of their budget than smaller governments (Table 4). In every population category, cities' average total expenditure on EDP is greater than counties'; but counties spend a greater share of their budget on EDP than do cities. This might be accounted for by the fact that county governments, relative to city governments, normally provide more large-scale

† It is important to note that the smaller local governments exhibit considerably less instability than the larger governments. Field research suggests that these instabilities are a function of the government's length of EDP utilization (rather than of size or of the nature of current technology). Thus it might be that the smaller governments will experience increasing instability.

‡ More extensive presentation of these data is found in Kraemer *et al.* [5] and Matthews *et al.* [6].

Table 4. U.S. city and county data processing 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.	Average total EDP personnel: User Depts.
		$				
Total, all cities	997	193	0.9%	43%	22.0	5.9
Population group*						
500,000 and over	20	3596	1.2	39	112.5	30.1
250,000–499,999	24	1108	1.1	37	39.2	11.7
100,000–249,999	74	474	1.1	35	19.6	5.8
50,000–99,999	190	157	1.0	47	7.6	1.7
25,000–49,999	266	66	0.6	...	...	...
10,000–24,999	423	28	0.5	...	...	...
		$				
Total, all counties	412	487	1.2%	44%	37.8	10.2
Population group						
500,000 and over	48	2708	1.8	34	95.6	24.9
250,000–499,999	51	811	1.8	45	29.6	9.5
100,000–249,999	117	292	1.6	48	14.3	3.4
50,000–99,999	75	76	0.6	...	...	...
25,000–49,999	58	42	0.5	...	...	...
10,000–24,999	63	25	0.6	...	...	...

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

record-keeping services (services such as voter registration lists, property tax assessment files, welfare and health care records) that are facilitated by automated applications. Also, the geographic spread of counties might make EDP attractive as a tool for integrating county functions and for facilitating the use of data by operating units that are geographically dispersed.

These comparative figures are based on direct EDP expenditures. If EDP-related expenditures in user departments and in management are included, the actual cost of EDP might account for 2–3% of total expenditure. In the governments surveyed, about 40% of the expenditures for EDP relate to equipment with the bulk of spending allocated to staff and software.

EDP staff size. Personnel in the EDP department comprise, on the average, about 1.0% of the total local government employees in cities and about 0.3% in counties. About one-fourth of the total EDP staff are analysts and programmers. As one might expect, the average number of EDP staff is directly related to government size. It is noteworthy that about one-fourth of EDP staff have been decentralized to user departments in the local governments surveyed.

Table 5. Selected characteristics of computing equipment and operations for U.S. cities and counties, by population

Classification	No. of governments reporting	Average number of CPU's	Average total core capacity in bytes	Median total core capacity	Average number of CRT terminals	Average no. of automated applications currently operational
			(K)	(K)		
All cities	663	1.2	155	94	9	17
Population group						
500,000 and over	20	4.0	1986	1536	72	65
250,000–499,999	28	2.1	531	328	19	41
100,000–249,999	79	1.4	227	144	6	38
50,000–99,999	178	1.1	89	32	2	23
25,000–49,999	174	1.1	54	22	...	6
10,000–24,999	184	1.0	27	16		8
All counties	281	1.4	296	156	14	33
Population group						
500,000 and over	39	2.6	1246	640	40	47
250,000–499,999	53	1.5	321	196	15	36
100,000–249,999	98	1.3	133	64	4	24
50,000–99,999	47	1.1	57	24	...	5
25,000–49,999	32	1.0	48	24	...	4
10,000–24,999	12	1.0	36	16		4

Leaders (. . .) indicate not reported.

Computer capacity. Computing capacity is closely related to government size and level of expenditure for EDP. Larger local governments often have more than one large mainframe, have large core capacities in their machines, and utilize time-sharing extensively (Table 5). However, the greatest proportion of local governments have only one mainframe, with small or medium core capacity and with batch computing. This limited capacity indicates that most governments cannot provide interactive data processing and probably cannot service more than a few departments in the local government with extensive applications.

EDP applications

In terms of total number of applications that are automated, larger governments tend to be much more extensively automated than smaller governments, particularly in counties (Table 5). The largest cities and counties average more than 45 different functional activities (from a list of over 250) that have currently automated applications. The average number of operational applications in the small governments is quite low, although there is substantial variation. It is evident that the use of EDP has penetrated the operations in moderate-sized city governments much more broadly than in the equivalent-sized counties. Although different governments have somewhat different functional responsibilities, it is valid to conclude that, in general, larger governments and city governments are more extensively automated.

Figure 2 examines the level of complexity rather than the sheer number of automated activities in local governments. The majority of EDP applications involve the automation of routine tasks—about three-fourths of all automated applications can be classified as 'information processing tasks' which do record-keeping or calculating/printing.† The remaining applications are distributed among the more sophisticated tasks involving record searching, record restructuring, sophisticated analysis, and process control. There is substantial similarity in the relative frequency of each type of information processing task for cities and counties.

A third method to characterize the EDP applications of local governments is to examine the number of applications in various functional areas. The largest number of automated tasks is in the area of accounting and financial control. Figure 3 characterizes the level of automation both within and between functional areas of local government. The vertical scale in the figure ('commonality') indicates the percentage of local

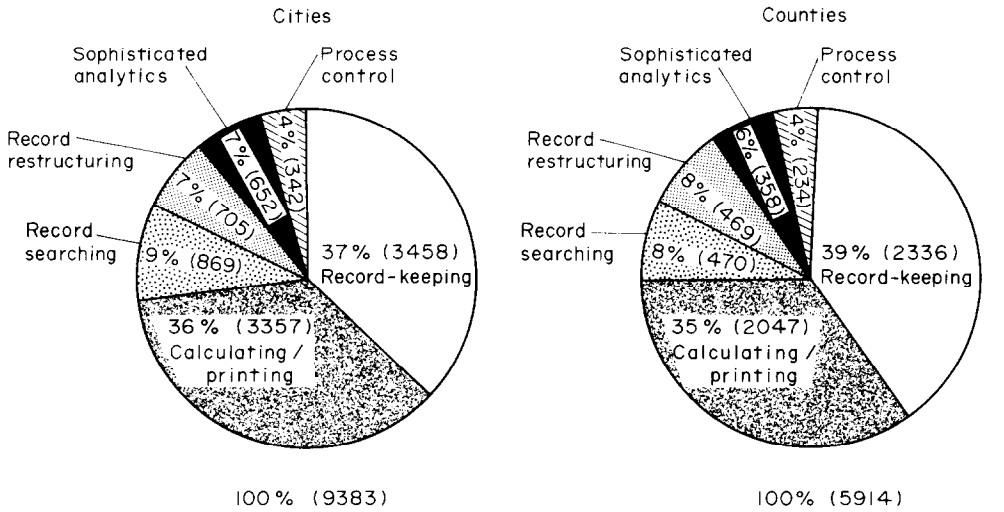

Fig. 2. Per cent of total operational computer applications in U.S. cities over 50,000 and counties over 100,000, by type of information processing task. Parenthesized numbers are the number of applications.

† This system of classifying information processing tasks in described in Danziger [7].

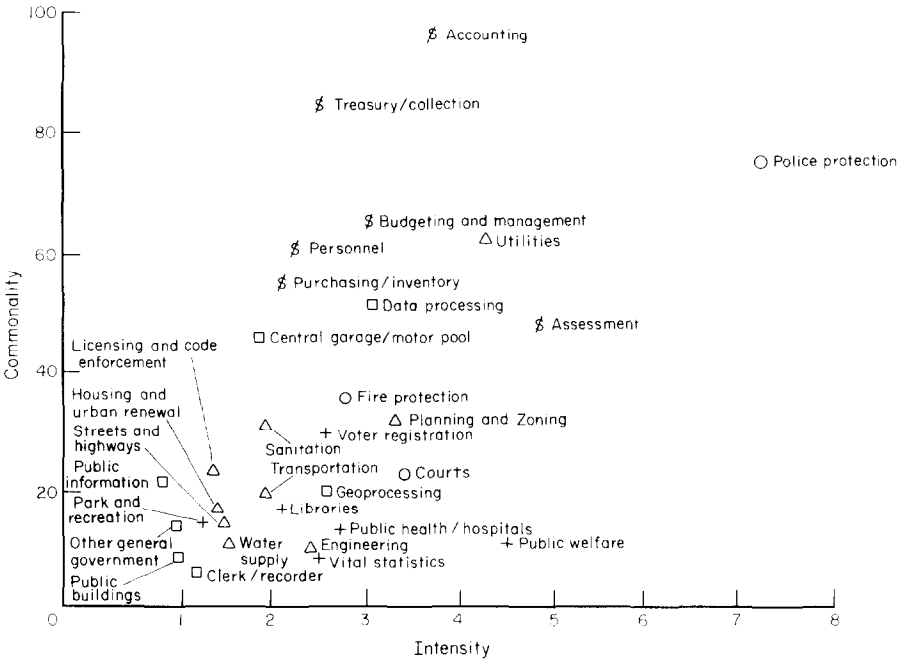

Fig. 3A. Commonality* and intensity† of computer automation in various municipal functions, cities over 50,000 population.

* Commonality equals the per cent of all cities reporting the current use of EDP which have one or more operational/planned applications in this area.

† Intensity equals the average number of operational/planned applications in the functional area for all cities with one or more applications operational in this area.

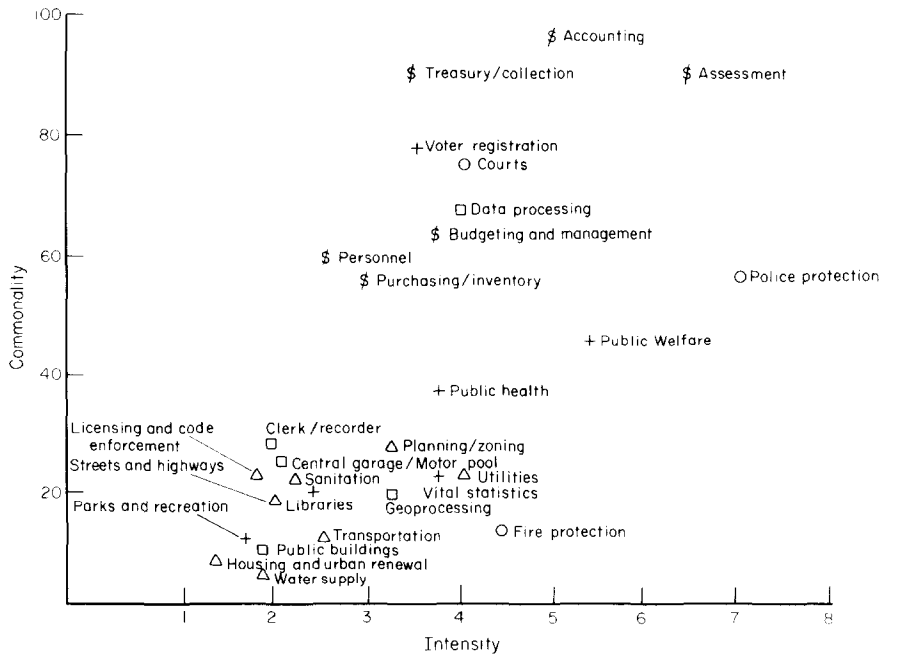

Fig. 3B. Commonality‡ and intensity§ of computer automation in various county functions, counties over 100,000 population.

‡ Commonality equals the per cent of all counties reporting the current use of EDP which have one or more operational applications in this area.

§ Intensity equals the average number of operational applications in the functional area for all counties with one or more applications operational in this area.

△ = Community development and public works; $ = Finance administration; □ = General Government; + = Human resources; O = Public safety.

governments that have applied EDP to a specific function. The horizontal scale ('intensity') indicates, for each specific function, the average number of automated applications per site in those cities and counties with at least one application in that functional area. Thus location higher in the figure reflects a functional area where EDP has been widely utilized across many local governments and location further to the right in the figure indicates a function which tends to be relatively more intensively automated.

In both city and county governments, it is the finance and police functions that are most commonly and intensively automated. The assessment function also shows a high level of automation in counties and in those cities which perform assessment. Certain record-keeping functions, particularly personnel and purchasing records, reflect high levels of EDP application. EDP use is also high for some record-keeping functions that are usually the responsibilities of counties, such as voter registration and administration of the court system. And in those sites (again, usually counties) where public welfare activities have been automated, the number of EDP applications is quite high. Among city functions, moderate levels of EDP use are found in the area of utilities.

Generally, the data in Figs. 3A and 3B suggest that the primary emphasis of EDP use in local governments has been on the revenue-producing and expenditure-controlling activities, on some administrative housekeeping activities, and on police activities. In other words, the technology has been applied primarily to facilitate activities of an administrative and social control nature. Moreover, it appears that EDP primarily serves local governments in the performance of internal bureaucratic tasks. To this point, there are relatively few applications of automation to functions that deal directly with planning and maintaining the physical environment or with providing human services. Over the next 2 years, applications most commonly scheduled for development are: revenue and expenditure forecasting; cash control; expenditure monitoring; police service and facility planning; and police manpower allocation.

II. THE IMPACT OF INFORMATION TECHNOLOGY ON LOCAL ADMINISTRATION

Overview

As indicated above, EDP in U.S. local governments primarily helps local government bureaucracies perform internal operations. To this point, there are very few computer-based applications that provide direct information or direct service to citizens.† With the exception of a few applications (e.g. health and welfare information and referral systems), the most direct contact most citizens have with local government computing is through the mail (e.g. utility and tax bills, voter notification).

Given this minimal impact of automation on direct service delivery to citizens, the question of impacts is best considered in another form: has EDP provided more timely, useful, comprehensive, and accurate information to local government employees and thereby enhanced their ability to make good decisions, maintain efficient operations, and deliver government services? The answer to this question is complicated. It is often extremely difficult to obtain consistent or clear measures of improvements in the 'value' of local government's activities.

We can begin to answer this question by considering the judgements of chief executives in city and county governments.‡ Although the chief executives offer only one evaluation of EDP impacts on local government, their perspective is the most comprehensive of all local government personnel. This section discusses the chief executive's evaluation of EDP impacts on operations, local government management, and local planning. These findings are based on questionnaire responses from about 80% of the chief executives

† Those applications which do exist are highly experimental and usually involve other information technologies, such as two-way cable communications, wherein the computer technology might be a small part of the total application.

‡ Chief executives include city managers, mayors, county administrative officers and county board chairmen. Complete discussion of the chief executive's views is presented in Kraemer *et al.* [8].

Table 6. U.S. city and county chief executive's beliefs about the operational impacts of computers and data processing

Question	Percentage indicating: Strongly agree	Agree	Undecided	Disagree	Strongly disagree
"In the future, the computer will become much more essential in the day-to-day operations of this government." (N = 564)	55%	39	5	1	0
"For the most part, computers have not reduced the cost of government operations where they have been applied." (N = 563)	9%	42	17	29	3
"Computers usually enable a reduction in the staff necessary to perform a task." (N = 564)	4%	28	25	39	5
"For the most part, computers have clearly increased the speed and ease of performance of government operations where they have been applied." (N = 565)	23%	60	13	4	0
"The use of computers and data processing results in greater cooperation among the operating departments and agencies." (N = 564)	6%	43	37	14	1

in the U.S. cities greater than 50,000 in population and counties greater than 100,000 in population. We integrate these views with our own appraisal, based on extensive field research.

Impacts on operational performance

The generally favorable attitude of chief executives toward EDP is indicated by the fact that 95% of them agree that the computer will become more essential to government operations in the future (Table 6). But their evaluation of current impacts is more ambivalent. A common rationale for obtaining computers has been the argument that EDP use enables a government to accomplish its functions with smaller staffs and lower costs. According to chief executives, this beneficial impact has not materialized. Fewer than one-third of the executives feel that computers have reduced staff for the operations to which they have been applied. Similarly, fewer than a third feel that computers have effected reductions in costs were applied. It is clear that EDP has facilitated cost and staff efficiencies in some cases. One obvious instance is where automation reduces the number of personnel needed to perform routine clerical tasks, such as calculating charges and printing bills. Also, computers can enable a government to avoid greater costs. For example, real property can be appraised at more frequent intervals and without hiring additional staff by using computerized regression analyses to estimate property values.

While there have been some staff/cost reductions and avoidance, chief executives do not feel that this widely claimed benefit of computing has been realized. Why not? The answer seems to lie in the problematic relationship between EDP use and a local government's overall cost and staff situation. Although the computer can eliminate the need for certain clerical personnel, automation itself creates a demand for technically-trained personnel both in the EDP function and user departments. Usually, the displacement of lower-paid clerks is offset by the need to hire higher-paid EDP technicians or user professionals. Moreover, clerks continue to be required for data entry. In fact, automation often stimulates the collection and entry of *additional* data, requiring even more data entry personnel. Also, it has been common for local governments to eliminate displaced personnel by natural turnover and retirement. In such cases, the impact of computerization is unclear, and there are additional short-run costs during the period when both the EDP operation and the excess staff are maintained [7, 9].

The clearest favorable impacts of EDP on operational performance have been in the automation of three kinds of applications. The first involves applications that require the processing of very large or complex files, such as land parcel records for taxing purposes, customer utility accounts for billing purposes, or traffic ticket files for following up on fines. The second involves applications that require the frequent search and updating of files, such as wanted persons files or stolen vehicle files in law enforcement.

The third involves applications where geographically dispersed locations need rapid access to centrally stored information, such as neighborhood health and social service centers that need immediate access to centralized client records. In these areas, computing probably has resulted in cost savings or cost avoidance, in improved information-handling related to service delivery or revenue-generation, in staffing efficiencies, or in all three. Thus despite the ambiguity of specific service delivery benefits from EDP use, over 80% of the chief executives agree that computers have in some way increased the speed and ease of government operations where they have been applied.

Impacts on coordination and control

Impacts of EDP on the capabilities of the government for coordination and control can be classified according to impacts on integration of governmental functions, on the relationship between supervisors and staff personnel, and on management decision making and control.

Integration of governmental functions. It has been postulated that EDP operations would tend to increase communication and coordination among the different departments within the organization [10, 11]. About one-half of the chief executives feel that interdepartmental cooperation has improved since the introduction of EDP, whereas fewer than 15% feel it has not (Table 6). The large number of undecided executives indicates that the impact of EDP on interdepartmental cooperation might be ambiguous or difficult to assess.

Supervisor/staff relationships. Another common prediction about EDP's impact on organizations has been that it would alter the relationships between staff personnel and their supervisors, primarily by improving the ability of a supervisor to monitor subordinates [10, 11]. Chief executives generally do not believe this has happened (Table 7). However, it is likely that subordinates would be more sensitive to this impact of computers than the top executive. Evidence from URBIS field work indicates that subordinates do feel they are being more closely supervised where their superiors have access to computer-generated workload statistics. Such situations are most apparent among patrol officers and detectives in police, welfare workers, and health service personnel.

Management decision making and control. A most interesting predicted impact of EDP on organizations was that it would greatly improve management's capabilities for decision making and control by increasing the quantity, quality, and timeliness of useful information [2, 10]. The great majority of local government chief executives agree that EDP generally has increased the amount of helpful information available for management decisions (Table 8). But most of the chief executives also believe that much of the potentially useful data currently gathered by their governments is not organized in ways that facilitate its use. In those sites where top management frequently receives information or reports based on computerized information, chief executives tend to perceive more favorable impacts from computers on decision making, operational performance, and administrative control [12]. Much of the improvement from automated information systems in these governments seems to result from the manager's increased capability to capitalize on the available decision data already existing in operational files. By use of aggregated information on government operations and by use of excep-

Table 7. U.S. city and county chief executive's beliefs about the impact of computers on the supervision of subordinates

"Has the use of computers and data processing significantly altered the relationship between supervisors and staff in departments which use them?"		Per cent indicating	N
No		70%	(338)
Yes, tended to give supervisors *more* control over staff		28%	(136)
Yes, tended to give supervisors *less* control over staff		2%	(10)
	Total	100%	(484)

Table 8. U.S. city and county chief executives' beliefs about information available for decision making

Question	Percentage indicating: Strongly agree	Agree	Undecided	Disagree	Strongly disagree
"In general, computers provide information which is helpful to me in making decisions." (N = 562)	28%	59	6	6	0
"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)	2%	18	16	58	7
"Much of the data gathered by this government in its daily operations is not collected or organized in ways that provide useful information about community conditions and government operations." (N = 561)	9%	47	15	26	3
"If properly designed and managed, much of the data gathered by this government in its daily operations could be collected and organized in ways that provide useful information about community conditions and government operations." (N = 559)	28%	63	7	1	0

tion reporting systems, many managers feel they have been able to improve their control over the operational activities of certain departments, over the personnel assigned to different tasks, and over budgeting, expenditure and cash flow.

Impacts on planning local futures

Computers might provide assistance for three kinds of planning activities: modeling the dynamics of the urban environment, monitoring change in the environment, and estimating the effects of specific government interventions in the environment.

The construction of elaborate computer-based models, particularly simulations, for predicting future conditions and for evaluating urban development alternatives is appealing. This kind of computerized urban planning assistance is uncommon in the United States today, although much experimentation with urban models occurred in the 1960's [13–16]. Three factors operate against successful implementation of such modeling as a useful tool in urban planning. First, the models themselves are often complex and involve many conceptual and methodological problems. Second, acquiring and maintaining reliable and valid data for the large-scale models is a costly task and is usually beyond the scope of a local government's continuing data collection activities. Third, such models, while useful to professional planners, typically have little overall impact in planning decisions. The planning process in most U.S. local governments is highly political and involves interactions among many competing interests. Thus, the results of any model tend to be only one of many critical factors in decisions about comprehensive planning.

Currently, the monitoring of environmental change is a more promising kind of computerized planning assistance, and it is occurring in some U.S. local governments. In these applications, EDP can provide the analyst or planner with the ability to gather data on a number of relevant variables, to construct social indicators from these data, and to measure and assess the changes in these factors over time. For example, such a system might be used to evaluate patterns of demographic change in order to identify areas of need for the location of future municipal service facilities.

The third kind of computerized planning assistance is the most common in local governments today. It involves the use of operational models to estimate the possible short-range effects of proposed or anticipated changes. Applications of this kind are illustrated in routing roads and utility corridors, scheduling public transportation, examining the impacts of alterations in local revenues and expenditures, and anticipating demands on municipal utilities such as water and electricity. In general, computerized planning applications, particularly the more modest ones, will be increasingly utilized as more sophisticated software diffuses to local governments and personnel gain confidence in its use and results.

III. CRITICAL ISSUES FACING LOCAL GOVERNMENTS IN THEIR UTILIZATION OF INFORMATION TECHNOLOGY

A number of important problems and issues relate to the ongoing utilization of EDP by local governments. These issues involve the development and management of EDP, the sharing of the technology, and the response to privacy and security concerns.

Development of information technology capability

Given the increasingly high percentage of U.S. local governments using computers, the question facing local government policymakers is no longer whether 'to adopt or not to adopt'. Rather, the key questions concern the rate and nature of EDP development, in terms of expansion of automated activities, upgrading of hardware and software, and anticipation of the changes caused by development.

The pressure to expand the range of automated activities is persistent, due to the inertial and almost endless dynamic of the EDP 'development phase'. In fact, the data processing installations surveyed report that, on average, their government has 6.0 automated applications 'currently under development'. Remarkably, they report over 23 additional applications which are 'planned for development within the next 2 years' [17]. While the feasibility of rapid development of as many automated applications as (on average) are currently operational is problematic, these figures suggest the expansionist perspective in many local governments. Given the ambiguous character of EDP impacts, it may be sensible for local government to counter the question 'what should be done next?' with the question 'should anything be done next?' At least, it appears local governments will benefit from considering a range of alternative approaches to the design or re-design of an automated task.

Development decisions are often justified on the basis of cost–benefit analyses. But local government EDP operations are quite difficult to evaluate in terms of costs and benefits because most generate public goods to which no 'market price' can be attached. And the attempt to undertake a cost–benefit analysis of the use of EDP on some functional task is particularly difficult [18, 19]. On the benefit side, placing a monetary (or any quantifiable) value on such outcomes as 'improved police protection' or 'more accurate government records' is quite problematic. Similarly, on the cost side, there are problems in correctly accounting for costs in a complex, time-shared technically sophisticated, and 'lumpy' resource like the computer and the staff supporting it. While some sort of cost–benefit calculus is advisable when making reasonable development decisions, decision makers often seem insufficiently sensitive to the slippery nature of cost–benefit estimates and the effect of biases in the estimators.

A final concern in the development of EDP stems from extraordinary development costs which result from instability in EDP operations. Unplanned changes, such as a sudden change in top EDP management, almost always generate substantial costs across the range of EDP services. Planned changes, such as the upgrading of computing equipment, new applications development, and the reorganization of the EDP operation, can be anticipated and possibly counteracted. But even such 'limited' development changes tend to have disruptive effects on a wide range of otherwise stable arrangements within the EDP operation, between EDP and users, and in users' own activities. The *cumulative* effects of these planned and unplanned disruptions in the data processing environment create costs that can reduce the level of 'net benefit' calculated for the implemented version of any single system or change.

Managing information technology. The discussion of development and instability relating to EDP suggest that EDP is not only a problem-solver, but also a problem-generator.† The key to successful utilization of EDP, it appears, is continual management attention and control. In particular, it is clear that top decision makers should take an active role in critical decisions about EDP development. Yet the data show that

† This idea was first articulated by Rob Kling of the URBIS Research Group.

to the extent chief executives are involved in EDP decisions, they tend to concentrate on equipment decisions [20]. This is somewhat understandable, given the cost and visibility of such decisions. But it is decisions relating to development priorities that most critically affect the nature and quality of the changing information environment.

Broadly, the EDP unit ought to be a service provider– that is, a provider of information processing services—to information users in the local government. The failure of top managers to control EDP and to insure that it serves the objectives of management itself and of users can have serious consequences. Ineffective control helps insulate the EDP function from being accountable to either management or user. If EDP is uncontrolled, it is likely to become a 'skill bureaucracy' within the local government: a self-serving organizational unit that dominates its own domain through its relative monopoly of technical expertise [17]. Like other skill bureaucracies, the EDP unit may be driven by its own imperatives to maintain its autonomy and freedom from control, to expand its activities, and to dominate the user client relationships.

The service provider role of EDP can be accentuated by positive management intervention. Managers can take an active role in priority-setting, and might chair a policy board which governs EDP use. The EDP unit can be put on a specific multi-year development plan that emphasizes short-term goals. Demand for EDP services can be regulated by a sensitive mixed pricing mechanism. Users can be given more control over the EDP unit by placing analysts or programmers directly in the user's chain of command. Service contracts between EDP and users might be established, with payment to EDP contingent on the fulfillment of specified levels of service. These actions can stimulate a service provider perspective within the EDP unit and might minimize its skill bureaucratic tendencies [17].

Sharing the technology

In recent years there has been considerable promotional discussion about the sharing of technology advancements among local governments. With respect to local government EDP, this interest in 'technology transfer' has centered in the inter-governmental transfer of EDP applications. The rationale behind the transfer argument is that by sharing applications with one another, local governments can capitalize on each other's developments and avoid the unnecessary costs incurred in 'reinventing the wheel'. Despite the intuitive appeal of this concept, a critical examination of transfer reveals some serious problems.

The extent of computer applications transfer among U.S. local governments is low [21]. Only 22% of the local governments have transferred any applications within the last 2 years, and only 23% plan to do so in the next 2 years (Table 9). Of the transfers that do occur, most involve simple, stand-alone applications that serve routine operational or middle management tasks such as payroll printing or report preparation. The hope that sophisticated EDP application packages would be broadly disseminated by transfer generally has not been realized.

Table 9. U.S. cities and counties, actual and planned transfer of applications

	Have transferred	Plan to transfer
Cities		
Per cent of governments	18%	22%
Average number of applications	1.4	1.5
Counties		
Per cent of governments	20%	25%
Average number of applications	1.6	1.9
Total, all cities and counties		
Per cent of governments	22%	23%
Average number of applications	1.5	1.7

[a] During the last 2 yr.
[b] During the next 2 yr.

Why hasn't applications transfer flourished? The notion of technology transfer is attractive; but it does not address certain realities of local government EDP situations [21]. There are two kinds of problems with transfer. The first problem is the assumption that transfer is an easy process and always saves money. In fact, transfers often face many difficulties which lead to costs that can exceed development savings. Since most automated applications are developed to meet the specific needs and characteristics of one local jurisdiction, they might not fit the needs of other governments: there might be serious differences in technical (hardware or software) compatibility; it might be hard to integrate the new applications into the EDP activities of the new site; the application might have been developed to fit a different set of government operating procedures; documentation might be insufficient. Moreover, local EDP staffs tend to be unenthusiastic about transferring-in and converting an application (tedious work) when they could develop the system themselves (EDP-as-craft). The second problem with transfer is that of underestimating the long-range value of in-house development, despite its higher initial costs. In-house development can have two particular benefits: (1) the application is tailored to the particular needs and characteristics of the local government; and (2) staff competence for effective maintenance and improvement of the application is an incidental benefit of in-house design.

Despite the current low level of transfer among local governments, most chief executives prefer obtaining computer applications by transfer from another government (52%) or from a private vendor (14%) rather than developing computer applications in-house (34%) [22]. This preference of the chief executives suggests top management support and pressure for future transfers.

It is likely that future improvements in EDP technology and in personnel skills will make the transfer of software applications components simple, efficient, and cost-effective. However, it might be that the most important current value of transfer is the possibility for greater sharing of approaches to EDP problems and sharing of concepts for automating tasks. This kind of sharing facilitates learning from the mistakes as well as successes of others.

Issues of privacy and security.

One of the most commonly cited concerns about the use of EDP in government is the problem of personal privacy and the security of sensitive data. This concern exists in many countries, and has resulted in the enactment of legislation designed to protect individuals from the misuse of personal information held in government records. In the U.S., this topic has been the subject of several congressional inquiries, a presidential commission, numerous task forces within government agencies, and a growing number of federal, state, and local legislative efforts aimed at the protection of individual privacy. In all these, computerized records of personal data are cited as being particularly hazardous to privacy [23].

Of the local governments surveyed, less than 20% of the chief executives reported that an individual or local group had complained about the collection or release of personal information. Most of the executives (73%) agreed that individuals should have the right to control a local government's use of information about them [22]. Despite the attention devoted to this issue, most records of personal data currently held by local governments are neither sufficiently detailed nor integrated to pose a major threat to privacy. But only one in five local governments have passed ordinances relating to the privacy and security of local government records. It appears that the stimulus for widespread institution of privacy ordinances will be either a serious privacy incident or pressure from state or federal legislation.

V. CONCLUDING OBSERVATIONS

This essay has attempted to provide a broad perspective on the experience of city and county governments in the United States with information technology. Given the

extremely rapid rate of change in EDP use by American local governments, a summarization of the current state of development in the technology seems the most appropriate 'conclusion'.

Virtually all of the larger city and county governments in the United States now use computers. Within another decade, all but the very smallest local governments will have adopted EDP technology. Despite widespread use of EDP, there is currently a substantial amount of variation between local governments in the extent to which their activities are computerized, in the sophistication of hardware and software employed, and in the organizational arrangements for controlling EDP.

The data indicate that local governments have developed EDP capability on their own, primarily in applications serving basic operations. However, a theme underlying this examination of local government EDP is that development of the technology has been relatively uncontrolled. If local governments are to maximize the benefits from the technology, it is clear that local policy-makers and managers will have to take a more active role in guiding the use and expansion of information technology. Among other things, this will involve continuous monitoring and control of the EDP operation by major appointed and elected officials.

Most current computer applications in local government are applied to routine, operational tasks. Yet it has often been difficult to specify clearly the impacts of these EDP uses on local government activities. Computers seem to have increased the speed and ease of operations on many tasks, to have reduced cost and/or staff on some basic clerical applications, and to have provided useful information to managers. But many of the expected benefits from applying information technology to the functions of local government are either unclear or unrealized.

A rhetoric has developed that claims computers can 'solve' urban problems. It is true that local governments, either through their own initiative or as implementors of federal and state policy, are attempting to respond to major social problems manifest in their areas. But computers generally have not had a direct impact on solving such problems. Rather, their impact has been indirect, through enhancing the ability of local governments to take effective action. For example, as urban governments face fiscal crises, the contributions of the computer to better financial management (e.g. more timely information during the budget-making cycle; more reliable cash flow data for investment decisions) and to greater efficiency and effectiveness (e.g. more frequent reappraisals of property values; follow-up systems which reduce billing delinquency rates) are certainly an assistance [24]. There are similar instances in nearly every sphere of local government where EDP has been applied.

A few projections can be made about the use of EDP in U.S. local governments over the next decade. There will be continued extension and development of automated applications in routine, internal operations of local government. Computer uses which facilitate management control and planning will also expand substantially. Moreover, there will be a continuing stream of experiments in which individual local governments attempt to apply sophisticated aspects of computer technology to a particular function. In addition to this relatively uncoordinated activity, institutional mechanisms will be established to facilitate the inter-governmental transfer of applications software.

Given a continuing fast pace of development of information technology, it is reasonable to forecast that EDP will be a significant transformer of the local government operation. Such development includes both the fuller mastery of existing technology over time and also the introduction of newer aspects of the technology, including minicomputers, micro-computers, cable communications networks, and data base management systems. At very least, the technology will continue to be a major source of instability for many established modes of operation in the government. In those local governments which are most innovative and ambitious in their use of information technology, one can predict a fascinating clash between the transforming capacities of the technology and the conservatizing tendencies of local government organization and personnel. More broadly, these technologies have the potential to alter and intensify the local govern-

ment–citizen interface through innovative applications that provide direct service or information to citizens. Given the history of technological innovations, it is likely that local governments will gradually muddle through toward increasingly efficient and constructive utilization of the developing information technologies.

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