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The Management of Computer Applications in Local Government

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■ This intensive study of 42 American cities finds that, *when well-managed,* computers have real payoffs for government operations. Unfortunately, computer technology is not well managed in most cities. As a consequence, computers often generate problems that, while not extreme, are often pervasive. Moreover, many of the payoffs fall far short of expectations.

The experience of a few cities, which have successfully managed the technology, however, indicates that the expected payoffs can be reasonably well achieved. One key to the computer's successful management lies in the policies used for the implementation of computing. This study concludes that the single most important policy influencing the success of computing is a commitment to advanced computer technology. Specifically, the more advanced the technology, the greater the payoffs from the computer's application. Other policies, such as user involvement and decentralization of computing, are important too, but currently they appear to have secondary importance in comparison with the state of the technology's development.

Computing has become a general purpose tool for American local governments, spanning such activities as monitoring departmental expenditures, paying employees, monitoring sick leave, sending utility bills, analyzing community demographic data, locating fire stations, allocating manpower, and forecasting the fiscal impacts of urban development.[1] Yet, the performance of computer technology in American local governments has been disappointing. Time and again, research has indicated that many of the expected benefits of computing are not being realized by most local governments.[2] For this reason, much research has focused on ways to improve the performance of computer technology in organizations.[3] While a wide array of recommendations has been generated by this research, many recommendations are contradictory, and most are based on case studies in a very limited number of governmental settings. The aim of the present study was to test empirically the various recommendations by using survey data that was systematically gathered in 42 American cities in 1976. This research was supported by a grant from the National Science Foundation and is more fully reported in *The Management of Information Systems* (Columbia University Press, 1981).

To create some order out of the seemingly disjointed debates in the literature and among practitioners, we began by classifying recommendations for computing management under two main headings: reform and post-reform. The reform approach has its historical roots in the 1920s when reformers were concerned with transforming local governments into "businesslike" organizations. This approach, when applied to computers, has led to recommendations that cities adopt advanced technologies,[4] which is also one of this study's main recommendations. The concept of "advanced technologies" involves not only the computer itself, but related components such as whether it is on-line or batch, utilizes data base management systems or less sophisticated file management systems, employs highly skilled and specialized personnel, and has made routine the process of computer innovation as opposed to treating each computer application as a discrete entity.[5]

The reform approach also recommends that computer management be structured along the classic pyramidal structure of authority so as to maximize efficiency.[6] Furthermore, a professional administrative atmosphere is advocated as the most compatible context for the efficient and effective delivery of government services.

As cities experiences with computers grew, however, the number of critics of the reform approach also grew. They pointed out that technology has not always solved the problems facing government, if it ever can.[7] Moreover, those critics, whom we call the post-reformers, have also noted that technology is rarely a solution to problems, and, in fact, it is often a source of new, unanticipated problems, such as employee resistance to automation. As a result, the post-reform approach to managing computers recommends the incremental adoption

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of computing applications and low sophistication of applications adopted. In addition, the management should be decentralized allowing for user participation in decisions and design. The post-reform approach also suggests that the best organizational atmosphere for computer management is a political administration, which is thought to improve performance by stressing responsiveness to the expressed needs of its own employees and of the public rather than responsiveness to abstract internal principles of professional management.

A multitude of quite specific computing policies can be derived from the reform and post-reform approaches to computer management. These in turn can be usefully classified according to four perspectives which suggest their underlying rationale: the development of the technology, the arrangement of bureaucratic-administrative structures, the nature of the socio-technical design, and the organizational context. Table 1 lists the four perspectives under their respective approaches to computer management. Other examples of policy recommendations derived from the approach are included in Table 4 as well as throughout this paper.

Today, the reform approach is most clearly articulated by the managers of local government data processing departments and their technical staffs. Very simply put, these managers generally advocate leading-edge technologies such as on-line computing and data base management systems, centralized control such as through an independent electronic data processing (EDP) department, the most efficient rather than the most user oriented systems designs, and a professional administration that isolates computing from "political" pressures.

In contrast, the post-reform approach is most clearly advocated by the nontechnical users of computing. Such users often wish to limit technological change in order to limit change in their tasks, roles, and status within the organization. Users are most likely to advocate decentralization of control through mechanisms ranging from user committees to oversee the computing department, to the location of computing facilities within their own department—a rather common plea with the advent of minicomputers. Likewise, users are the major advocates of user-centered designs, such as the use of interactive systems and the adoption of higher level programming languages and generalized statistical packages that require less technical expertise to operate. Finally, users are often opposed to professional administration, as it generally means greater top management control and less departmental (user) autonomy. Instead they favor a more political administration.

Using survey data that was systematically gathered in 42 American cities, this paper will argue that in fact a mix of the reform and post-reform approaches to computer implementation results in better managed systems with real payoffs for government operations.

Methods

This study, called "Evaluation of Information Technology in Local Governments," was carried out from 1975 to 1980 by the Urban Information Systems (URBIS) research group of the Public Policy Research Organization (PPRO) at the University of California, Irvine.

Our research purpose was to prescribe policies for "future cities," rather than simply to describe policy impacts in present cities. We wanted to answer what would happen if cities did X (where X is a policy to decentralize computing, or to automate more, and so forth). Answering this type of question required us to make the best possible estimates of the effects of management policies, as well as environmental characteristics of the cities, such as city size and growth.

Two conventional approaches to deriving such answers were not chosen. The most conventional approach is an experimental design in which conditions are controlled such that only the policy variables are

TABLE 1
The Reform and Post-Reform Approaches

Perspective	Approach with Examples of Policy Recommendations: Reform	Post-Reform
Technological development	Advanced technology: on-line, complete automation of all applications, data-base management systems	Appropriate technology: batch incremental adoption, and in some cases no automation
Structural arrangements	Classical structures: central source of computing, only top management involvement in design	Participatory structures: multiple decentralized sources of computing, user involvement in design
Socio-technical design	Task efficiency: design data entry on the basis of time and cost only	Human relations: design data entry so it has positive impact on work environment and morale
Organizational context	Professional administration: impartial administrative decision-making guidelines	Political administration: sensitivity to community groups and city hall employees' demands in decision-making

manipulated to examine how they affect the policy outcome variables.[8] The natural settings of the governments, however, do not allow for such control, and so we chose not to await the occurrence of natural experimental conditions.

A second conventional approach is to sample cities randomly and then to control statistically for other policies and city characteristics, thereby determining the impact of a given policy on performance.[9] Such a design would be useful if the sample were quite large, if the policies of interest would be adequately represented in a random sample, and if the effects of each policy were easily distinguishable. Resources, however, limited us to sampling about 40 cities; many policies of interest are rare and, therefore, would be underrepresented in a random sample; and policy outcomes are expected to be quite difficult to discern, given the large number of other variables (noise) affecting the same outcomes. Consequently, the random sample approach would be fruitless, for we would be unable to answer our research questions.

Our major problem, then, was to fashion a research design, based on a small sample, which incorporated variation on the major policy variables and which maximized the likelihood of discerning any policy outcomes. Our response was a fusion of research methods that constitutes a modest design innovation. By drawing a highly stratified random sample of 40 cities (stratifying simultaneously on six policy variables), we ensured adequate variation of important policies and substantial statistical independence among these policies, such that their independent effects could be assessed.[10] Moreover, by selecting half of the cities on each policy variable from the rare policy extreme, we increased the chances that any policy outcomes would be distinguishable. This stratified technique serves as the basis for drawing conclusions that apply to "future cities" instead of just describing policies in cities today, given that the large number of other variables affecting performance are reduced immensely by this technique. In effect, we are separating out policies from their political, administrative, and demographic context by the factorial design.

Once our 40 cities were selected with two extra cities chosen to compensate for refusals (Table 2), our next step was to decide on which information-processing tasks to study.

"Information-processing task" is a term used to signify an activity that has a specific objective, explicitly involves information processing, and *might* be automated.[11] For example, most cities regularly issue a payroll, which involves translating records of hours worked, pay rates, and payroll deductions into a payroll check. Thus "payroll processing" can be designated an information processing task (IPT). Similarly, the searching of a file of utility customers for unpaid bills is an IPT, "utility customer inquiry."

The IPT is an attractive unit of analysis, for it permits more objective and quantifiable observations of computer impacts. There are, however, 300 such IPTs covering the full range of services provided by most city

TABLE 2
Cities Visited in Phase II Study[a]

	Population		Population
Albany, NY	115,876	Milwaukee, WI	717,124
Atlanta, GA	497,024	Montgomery, AL	183,471
Baltimore, MD	905,759	New Orleans, LA	593,471
Brockton, MA	89,040	New Rochelle, NY	75,385
Burbank, CA	88,580	Newton, MA	91,073
Chesapeake, VA	89,580	Oshkosh, WI	53,155
Cleveland, OH	751,046	Paterson, NJ	144,830
Costa Mesa, CA	72,729	Philadelphia, PA	1,948,609
Evansville, IN	138,690	Portsmouth, VA	110,963
Fort Lauderdale, FL	139,543	Quincy, MA	87,966
Florissant, MO	66,006	Riverside, CA	139,269
Grand Rapids, MI	197,534	Sacramento, CA	254,362
Hampton, VA	120,779	San Francisco, CA	715,674
Kansas City, MO	507,242	San Jose, CA	446,504
Lancaster, PA	57,589	Seattle, WA	530,890
Las Vegas, NV	125,641	Spokane, WA	170,516
Lincoln, NB	149,518	St. Louis, MO	622,236
Little Rock, AK	132,482	Stockton, CA	107,459
Long Beach, CA	358,673	Tampa, FL	277,736
Louisville, KY	361,453	Tulsa, OK	331,800
Miami Beach, FL	86,974	Warren, MI	179,234

[a]This listing gives the names and 1970 Census populations of the municipalities visited. They were selected according to a stratified sampling process to assure a wide diversity of data-processing environments.

TABLE 3
Types of Information-Processing Tasks and Associated Applications

Type	Characterization	Applications Chosen
1. Record-keeping	Activities which primarily involve the entry, updating, and storage of data, with a secondary need for access; the computer facilitates manageable storage and easy updating for nearly unlimited amounts of information.	Traffic-ticket processing
2. Calculating/printing	Activities which primarily involve sorting, calculating, and printing of stored data to produce specific operational output; utilizes the computer's capabilities as a high-speed data processor.	Budget control (reporting)
3. Record searching	Activities where access to and search of data files is of primary importance; by defining parameters, relevant cases can be retrieved from a file with speed and comprehensiveness; on-line capability of computer is particularly useful.	Detective investigative support Patrol officer support
4. Record restructuring	Activities which involve reorganization, reaggregation, and/or analysis of data; the computer is used to link data from diverse sources or to summarize large volumes of data as management and planning information.	Policy analysis
5. Sophisticated analytics	Activities which utilize sophisticated, visual, mathematical, simulation, or other analytical methods to examine data; the special capabilities of computers make possible the manipulation of data about complex, interdependent phenomena.	Patrol manpower allocation
6. Process control	Activities which approximate a cybernetic system; data about the state of a system is continually monitored and fedback to a human or automatic controller which steers the system toward a performance standard; the computer's capability for real-time monitoring and direction of activities is utilized.	Budget control (monitoring)

governments, although the IPTs do cluster in functional areas. Therefore, to be able to generalize beyond any specific IPT and also to investigate IPTs in a systematic and empirical fashion, which demands an in-depth analysis, we needed a small sample of IPTs.

IPTs were sampled on the basis of two criteria. First, we wished to generalize beyond any specific type of activity which an IPT involves; therefore we sampled IPTs from each of six generic types, which we label record-keeping, calculating/printing, record searching, record restructuring, sophisticated analytics, and process control. Each type is shown in Table 3 in terms of its general characteristics and the specific IPT(s) studied. As the table illustrates, each IPT varies most importantly by the degree of sophistication in the information processing involved.

Second, project resources limited us to investigating only a few IPTs, but we wanted to generalize beyond any single functional area of governmental services. Hence, we chose six IPTs within four functional areas:

Police
1. Police-Manpower-Allocation Support
2. Detective Investigative Support
3. Patrol Officer Support

Courts
4. Traffic Ticket Processing

Finance
5. Budget Control

Planning and Management
6. Policy Analysis

Thus, by focusing on six specific IPTs within six generic types of tasks and four functional areas, we could generalize beyond any particular IPT or functional area and also collect objective indicators of policy outcomes.

Each city selected for Phase II was visited. Six investigators, including the authors, spent an average of three person-weeks in each of eight or more sites as part of a larger project team. Project members conducted about 40 personal interviews with elected officials and municipal personnel in each city in order to complete questionnaires designed specifically for each IPT.

Questions covered present policies such as source and location of computing services, sophistication and extent of automation, and participants in computing decisions and design, as well as performance indicators such as crime clearance rate, caseload, and patrol arrival time. In addition, between 50 and 100 self-administered questionnaires were completed by the users of computer services in each city that addressed their attitudes about, style of, and frequency of computer use.

Once the data were collected, we constructed our indicators of performance (information for decision making, management control, and operational performance), and of implementation policies (technological development, structural arrangements, sociotechnical design, and organizational context). The construction of the dependent variables was unique for each IPT studied because the performance of, for example, manpower allocation programs must be judged by different criteria than, say, the performance of traffic ticket processing. For instance, the performance of traffic ticket processing was based on the following variables: percentage of parking violation tickets paid, percentage of moving tickets paid, number of clerical personnel per 100,000 tickets issued, number of new services, EDP cost savings, EDP staff savings, and an increased payment scale. The construction of the independent variables also tended to be unique for each IPT because the computer installation servicing the police department may not have been the same installation as that servicing the finance department in a given city.[12] Moreover, each of our six IPTs has its own specialized computer applications and must be evaluated in terms of their number, sophistication, and routinization.

A correlational design was used to assess the degree of statistical association between each implementation policy and each IPT's performance. Then, multiple regression analysis was employed to estimate the independent and combined effects of each policy on each IPT's performance index. Throughout, multivariate techniques were used also to assess whether the observed relationships between policies and impacts could be explained or statistically accounted for by nonpolicy variables in our analysis, such as city size or growth.

Findings

Table 4 is a reduced list of the implementation policies studied and their relationships with performance measures for each IPT. For this table we chose implementation policies that were similar from IPT to IPT. Our aim in presenting this table is to show the reader that many implementation policies vary in their effectiveness across the various IPTs. Table 5 presents our regression findings for each IPT. The latter table indicates the policies that significantly improve performance for the specific IPT in question.

Technology

Both tables show that technological development is associated with the performance of computing for nearly every information processing task investigated. It might well be the *most* important perspective for understanding the performance of computing in traffic ticket processing, detective and patrol support, and policy analysis. Also, technological development was found to affect clearly the performance of budget reporting and monitoring applications. Only for patrol manpower allocation systems is the role of technological development unclear, owing to the minimal technological variation among police departments (Table 5).

An advanced technology strategy is uniformly linked to the success of implementation. That is, higher performance is associated with high levels of automation, more sophisticated applications, higher levels of computer utilization, and greater routinization. In no case is such advanced technology associated with lower performance. Therefore, Figure 1 shows advanced technology as the recommended approach to technological development for each IPT except patrol allocation analysis. Even in this case, though, advanced technology is our tentative recommendation.

The success of advanced technology has a rather straightforward explanation. While many so-called advancements in computer technology are cosmetic, many also are incremental improvements that cumulatively create fundamental improvements in the value of computing to users. For example, the increased reliability and storage capacity of modern hardware is a major benefit to users. Also, on-line processing increases the speed and ease of access to computerized files, as well as increasing the accuracy and timeliness of data by permitting the immediate and continuous updating of files from various locations. In addition, direct personal access via terminals in user work areas often enhances the user orientation of automation. Moreover, recent technological advances—such as data base management systems and generalized statistical software packages—facilitate more complex and flexible restructuring, reaggregation, analysis, and presentation of data in computer based files. In short, many of the advancements in computer technology over the last two decades might be considered analogous to the advancement represented by moving from candles to an incandescent lamp, rather than simply increasing the intensity of a lamp.

The current approach of local governments toward technological development, however, approximates appropriate technology more closely than it does advanced technology (Figure 1). Consequently, current trends do not point toward a bright future for cities. There continue to be advancements in the available computer hardware and software to support such tasks as detective investigative support, patrol allocation analysis, and budget control. But the widespread diffusion of the more advanced, as opposed to the more conventional technologies is unlikely. With the end of federal funding from the Law Enforcement Assistance Administration, there is likely to be a slowdown in the adoption of ad-

TABLE 4
Pearson Correlation Between Implementation Policies and IPT Performances

Selected Implementation Policies	(N=32)	(N=28)	(N=22)	(N=31)	(N=35)	(N=41)
Technology						
Number of automated applications	.42*	.45*	.49*	.32*	.38*	.29*
Number of on-line applications	.21	.51		−.04	.27	
Routinization–1st year of automation	−.01	−.18	−.65*	−.14	.05	−.09
Degree of computer utilization	.11	.23	.30	−.13	.05	.43*[a] .65*[b]
Technological Instability	.10	.10	−.34	.06	−.12	.05
Structure						
User involvement in design	−.19	.47*	.44*	.25	.23	.25[c] .28*[d]
Decentralization	−.25	.30	.33	.15	−.12	.36*
Charging for computer use	−.25	−.35	.43*	−.50*		.12
Socio-Technical Design						
Job pressure	−.05	−.45*	−.20	−.11	.06	
Support for computing						−.21
Organizational Context						
Slack financial resources	.41*	.03	−.47*	.25	−.16	−.45*
Council-manager government	−.05	.16	−.16	−.24	.51*	−.01
Professional management practices	.09	−.01	.29	−.15	.14	.44*
Partisan environment	−.04	−.24	.09	.26	−.37*	.20
Community Environment						
Total population, 1975	−.02	.21	.13	.25	−.12	.32*
Population growth, 1970-75	.36*	−.01	−.31	.06	.24	−.29*

*$p < .05$.
[a]Management.
[b]Planning.
[c]Manager.
[d]Analyst.

vanced technology even for the police.[13] Only in the area of budget control is the current fiscal crisis likely to spur interest in the wider adoption of technologically advanced applications, such as highly integrated financial accounting systems.

Structural Arrangements

Structural arrangements shape the success of implementation for most information processing tasks. Only in the case of patrol officer support and policy analysis do structural arrangements appear to be relatively unimportant to performance (note their absence in Table 5), but some indications point to a small role there, too (Table 4).

The most successful strategy in terms of structural arrangements appears to be highly contingent on the routineness of automated information processing. The classical-structure strategy of a single computing source is clearly beneficial for the implementation of traffic ticket processing applications (Table 5). In contrast, the participatory-structures strategy of user involvement in design tends to be more beneficial for the implementation of detective and patrol officer support as well as patrol allocation, budget control, and policy analysis (Table 4).

One interpretation of this discrepancy across tasks is that the appropriate structural arrangements are unique to each task to which computing is applied. An alternative interpretation is that there are particular classes of information processing tasks for which classical or participatory strategies might be most appropriate. Our study supports this latter interpretation. Classical strategies are more appropriate for routine tasks, whereas participatory strategies appear most appropriate for nonroutine tasks.[14] Traffic ticket processing is representative of routine tasks. These are generally clerical record keeping and calculating-printing tasks, which involve large volume, routine, and repetitive operations, performed according to standard operating procedures. Computing for such routine clerical tasks is not a sup-

TABLE 5
Significant Path Coefficients for High Performance Indicators for Each IPT

Independent Variables	Path Coefficient[a]	Variance Explained (%)
Traffic Ticket Processing Performance		
Number of automated operations	.52	18
Multiple computing sources	−.38	13
Detective Performance		
Degree of local automation	.46	41
Job pressure	−.54	19
User involvement in design	.35	9
Partisan environment	−.29	8
Patrol Performance		
First year of automation	−.75	42
Professional management practices	.46	20
Manpower-Allocation Performance		
Elected-official control of EDP decisions	−.41	25
Charging policy	−.42	15
Police computer-specialist involvement in design	.33	11
Budget Performance		
Job satisfaction due to computing	.54	30
Level of partisan government	−.35	16
Number of on-line terminals	.43	13
Reformed government structure	.33	8
Policy Analysis Performance		
Management-oriented computing	.50	48
Sophistication of databank reports	.32	10
Slack financial resources	−.28	8

[a]All path coefficients are significant at the .05 level.

port tool; rather, computing is the essential tool by which the task is performed. Computing plays a similar role in other routine operations, such as utility and tax billing, financial accounting, payroll processing, and regular reporting. Consequently, these also might benefit from a classical strategy for implementation of computing.

Budget control, manpower allocation, policy analysis, and investigative support illustrate nonroutine tasks. They are distinguished by their need for more flexible, less routine, and more individualistic computer support. Detectives must imaginatively use many data files to distill the most useful information from criminal leads that vary greatly from case to case. Likewise, budget analysts need the capability to examine expenditures from multiple perspectives—program, department, project, line item. Consequently, computing tends to be used as a support tool for these tasks—a tool which involves considerable discretion by the user. Budget analysts, manpower analysts, patrol officers, and detectives need systems that are responsive to their needs and sensitive to the kinds of quantitative and qualitative information they need. In such nonroutine tasks, user involvement, decentralized control, and other participatory structural arrangements are likely to be more successful.

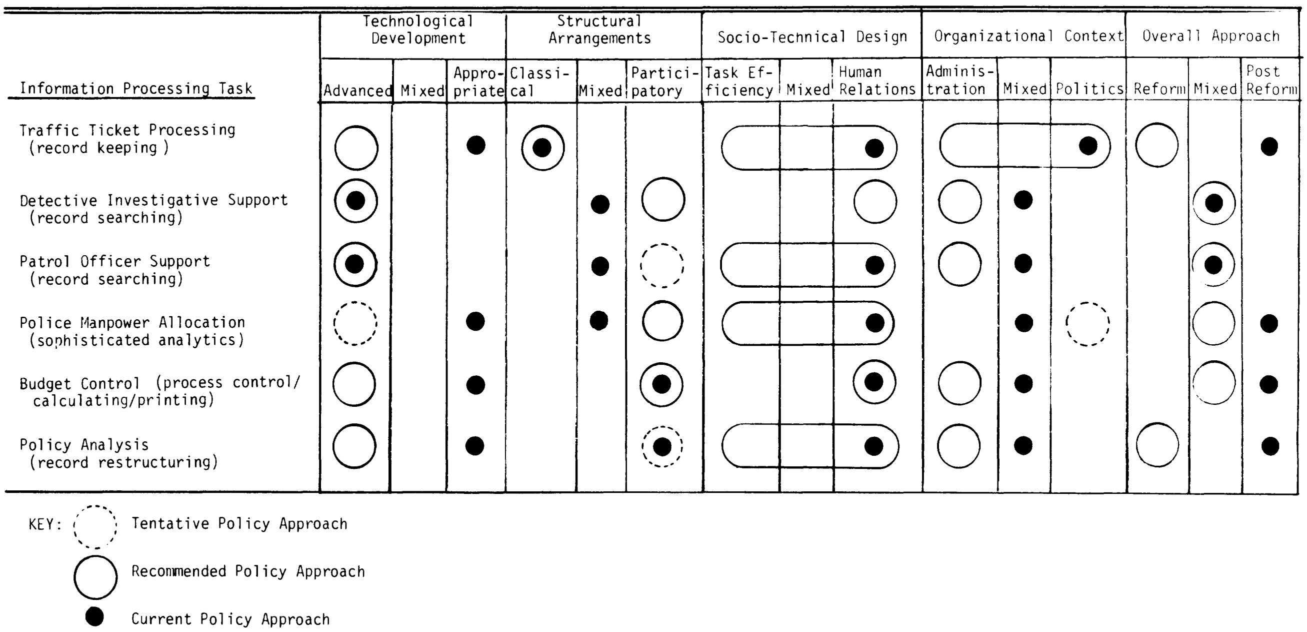
Current structural arrangements of local governments are either a mixture of classical and participatory arrangements or in line with a participatory perspective (Figure 1). The only exception is the correct use of classical strategies in traffic ticket processing.

Current trends suggest that cities will continue to follow a participatory strategy. Trends toward participatory structures in the police function are becoming prevalent, especially in the larger cities where computer installations are becoming common. Therefore, the structural arrangements associated with the implementation of most imformation processing tasks are likely to be pressured toward the participation strategy, even if this strategy is not always beneficial, as in the case of routine tasks.

Sociotechnical Design

Sociotechnical design can be considered the least important perspective for understanding the success of im-

FIGURE 1
Current and Successful Approaches to Computing by Tasks



plementation (Tables 4 and 5). For two tasks, however —detective support and budget control—sociotechnical design had an important role in predicting the performance of computing operations (Table 5, job pressure, job satisfaction). Furthermore, other analyses show sociotechnical design to be especially important when considering the performance of computing at the *individual* rather than the task level.[15] Thus, we do believe that the sociotechnical-design perspective should be carefully considered during the implementation process.

Interestingly, the two tasks—investigative support and budget control—in which human relations were found especially important are the two in which decision makers are often the direct users of computing. In each of these tasks, the best human relations strategy appears to be the design of systems which permit users easily to access information that is more accurate and timely. This is a difficult task in both police and finance information systems. Not only is the information difficult to keep timely and accurate, but the users of such information are likely to have a lower tolerance for error than many other users.

The current approach of cities toward sociotechnical design more closely approaches human relations than task efficiency for every IPT investigated (Figure 1). Cities have generally implemented systems that are quite sensitive to the work environment of users. This human relations approach may well explain why we have found from our 2,636 user questionnaires widespread support for computer operations and a general belief that computing improves the work environment of local government personnel.

Organizational Context

The organizational context is one of the least controllable perspectives but certainly an important one for understanding the success of implementation. Indeed, the organizational context is associated with the performance of computing in investigative support, budget control, and policy analysis, though not in traffic ticket processing (Table 5).

When the organizational context is associated with performance, a professional administration is almost uniformly more successful in the implementation of computing than is a more political administration (Table 4). Given that computing was promoted early on as a tool of administrative reform,[16] it is not surprising that the reformed and professionalized organization is normally more congenial to the implementation and use of computing.

Patrol allocation analysis, however, represents an interesting exception. For this task, a political context appears to be associated with more successful performance (Tables 4 and 5). This might indicate that the political context is more congenial to the adoption and use of automation for manpower allocation. We believe that an alternative, and perhaps more plausible, interpretation is that a political context creates a greater need for the reallocation of manpower on the basis of rational (need for service), as opposed to political, criteria. The use of automated patrol allocation analyses is a means for professionals within the police department to overcome their political context, since it aids them in the documentation and legitimation of their allocation decisions. Thus, the introduction of automated patrol allocation analysis within a political context will effect the greatest changes in allocations and performance.

Currently, the organizational context of most local governments is mixed (Figure 1). Most local governments have aspects of both professionalism and politics. The council-manager form of government has been widely adopted but is facing increased criticism as local politics becomes characterized more by conflict than by consensus. The development and adoption of professional management practices also is widespread and fashionable, as illustrated by the spread of planning, programming, and budgeting (PPB), zero-based budgeting (ZBB), and management by objectives (MBO) budgeting techniques. Here too, however, there is a growing disenchantment with professional management. Most recently there is the less professional practice of resorting to the tax cut as the means for achieving economy and efficiency in government.

Thus, trends are in a flux. To the degree that the shift is toward the principles of politics as opposed to the principles of professionalism, the performance of local government computing operations is likely to suffer.

The Community Environment

Local government managers operate within an environment that is more or less outside of their short run control, however, the community's environment is unlikely to shape and condition the performance of computing operations. We have found management strategies to be far more relevant than environmental variables to implementation success in local government automation (Tables 4 and 5).

Conclusion

We have found that computing tends to pay off—to provide the intended benefits—when properly managed, however, local government approaches to the management of computer technology are off target (Figure 1). For the most part, local governments have heeded the advice of post-reform advocates over that of reform advocates. The management strategies for implementing automation and for managing it once the implementation phase is over are characterized by appropriate technology, participatory management, human relations, and a mix of a professional and a political administrative context. Yet our research suggests that the most successful policy-technology mix combines aspects of the reform approach with the post-reform approach. Most importantly, local governments should carefully consider the merits of advanced technology and a professional administrative context for the implementation of computer-based information systems.

Of course, not every organization is able to follow our policy recommendations, in that some recommendations might be economically or politically infeasible for a particular city. In fact, with today's budget constraints most cities will not be able to afford advanced technology and the sophisticated personnel necessary to support advanced technology. Moreover, some highly political organizations cannot develop a more professional administrative context simply for better implementation of computer applications. In such cases, advanced technology is likely to be less warranted, even if the potential impacts of the technology are benign and attractive. Consequently, knowing the most appropriate mix of technology, structure, sociotechnical design, and administrative context is not sufficient in itself, but it is an important step.

Notes

1. See Kenneth L. Kraemer, William H. Dutton, and Joseph Matthews, "Municipal Computers," *Urban Data Services Report,* Vol. 8, No. 2, 1975, pp. 1-15, and Joseph R. Matthews, William H. Dutton, and Kenneth L. Kraemer, "County Computers: Growth, Usage and Management," *Urban Data Service Report,* Vol. 8, No. 2, 1976.
2. Examples of these studies include: Kenneth W. Colton, *Police and Computer Technology* (Lexington, MA: Lexington Books, 1978); James N. Danziger, "Computers, Local Governments, and the Litany to EDP," *Public Administration Review,* Vol. 37, No. 1 (January/February 1977); William H. Dutton and Kenneth L. Kraemer, "Technology and Urban Management," *Administration and Society,* Vol. 9, No. 3 (November 1977), pp. 305-340; Rob Kling, "Automated Welfare Client Tracking and Service Integration," *Communications of the ACM,* Vol. 21, No. 6 (June 1978), pp. 424-493; Kenneth L. Kraemer, William H. Dutton, and Alana Northrop, *The Management of Information Systems* (New York: Columbia University Press, 1981); Kenneth C. Laudon, *Computers and Bureaucratic Reform* (New York: John Wiley and Sons, 1974); and David Leo Weimer, "CMIS Implementation," *Public Administration Review,* Vol. 40, No. 3 (May/June 1980), pp. 231-240.
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4. J. C. Pendleton, "Integrated Information Systems," *AFIPS Conference Proceedings,* 1971 Fall Joint Computer Conference, Montvale, NJ: AFIPS Press, Vol. 39, pp. 491-500; Herbert Simon, *The Shape of Automation for Man and Management* (New York: Harper and Row, 1965).
5. Micro- and minicomputers also can be considered components of advanced technology but by themselves they are not. However, micro- and minicomputers were not studied in this survey, and thus it is unclear how our findings would apply to micro-and minicomputers as components of advanced technology.
6. See Richard L. Nolan, "Managing the Computer Resource: A Stage Hypothesis," *Communications of the ACM,* Vol. 16, No. 7 (1973), pp. 339-405.
7. See Robert Golembiewski, *Public Administration as a Developing Discipline, Part I: Perspectives in the Past and Present* (New York: Marcel Dekker, 1977); Vincent Ostrom, *The Intellectual*

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8. See Donald T. Campbell, "Reforms as Experiments," *American Psychologist,* Vol. 24, No. 4 (1969), pp. 409-429; Donald T. Campbell and Julian C. Stanley, *Experimental and Quasi-Experimental Designs for Research* (Chicago: Rand-McNally, 1963); Edward A. Suchman, *Evaluation Research* (New York: Russell Sage Foundations, 1967).
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11. See Kraemer, *et al., ibid.*
12. Detailed operational definition of each variable can be obtained by writing the authors at PPRO, University of California, Irvine, CA 92717. The total discussion of all variables fills 60 pages of text.
13. See Kenneth L. Kraemer and James L. Perry, "The Federal Push to Bring Computer Applications to Local Governments," *Public Administration Review,* Vol. 39, No. 3 (May/June 1979), pp. 260-270 for a discussion of the problems stemming from federal support for local computer applications.
14. For a partial description of our findings in regard to the distinction between routine and nonroutine applications see Russell Ackoff, "Management Information Systems," *Management Science,* Vol. 14, No. 6 (1967), pp. 147-156; Kent Colton, *Police and Computer Technology: Use, Implementation and Impact* (Lexington, MA: Lexington Books, 1978); Anthony G. Gory and Michael S. Morton, "A Framework for Management Information Systems," Sloan School Working Paper 458-70 (Cambridge, MA: MIT, Sloan School of Management, Mimeo, 1971); Herbert A. Simon, *The New Science of Management Decision* (New York: Harper and Row, 1960).
15. See Kenneth L. Kraemer, James N. Danziger, and William H. Dutton, "Automated Information Systems and Urban Decision Making," *Urban Systems,* Vol. 3, No. 4 (1978), pp. 177-190.
16. See Kenneth C. Laudon, *Computers and Bureaucratic Reform* (New York: Wiley, 1974). See William H. Dutton and Kenneth L. Kraemer, "Determinants of Support for Computer-Based Information Systems," *Midwest Review of Public Administration,* Vol. 12, No. 1 (1978), pp. 19-40.