Social Impacts of Computing
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Computers as an Innovation in American Local Governments

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Computers and electronic data processing are a major technological innovation in the operations of American local government. This paper establishes that there is substantial variation among the larger local governments in the rate at which they adopt computer technology, in the level of financial support they provide for EDP, and in the extensiveness and sophistication of their automated applications. The central question addressed is: What might explain the differences between governments in the extent to which they adopt and use computers? Hypotheses are tested for several streams of explanatory factors, using data from more than 500 city and county governments. The findings identify certain local government milieus which are particularly conducive to higher levels of computer innovation. Somewhat unexpected findings reveal the significant impact of the distribution of control over EDP decisions and the dominant political values within the government. Other important factors include the measured need for computer applications and the presence of external funding support for computing. Finally, the paper suggests a framework for identifying the key determinants of other technological innovations.

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Introduction

The severity and urgency of the demands placed upon American local governments have increased substantially in the last decade, and talk of an "urban crisis" has become commonplace. One of the most important responses to these conditions has been the introduction of computer technology into the operations of local governments. Local government decision makers, like those in many other organizations, have been attracted to the use of computers and electronic data processing by claims that computers can have a role in reducing costs, in increasing the productivity of personnel, and in enhancing the speed, quality, and comprehensiveness of information for decision making and service delivery.

Given these claims and the declining costs of increasingly sophisticated computer hardware and software, it is not surprising that most local governments now use EDP in some manner. But, as we shall show, local governments vary *substantially* in the speed with which they have adopted computers, in the extent to which they have automated their operations, in the level of investment in EDP, and in the sophistication of their data processing capabilities. *What might explain these differences between governments in the extent of their adoption and use of computers and EDP?* This is the central question addressed in this paper.

Most people who have had direct experience with the use of computers have an intuitive understanding of the conditions under which EDP is adopted and then extends among the operations of an organization. To progress from these kinds of insights to a more general understanding of these conditions, it is useful to analyze data which measure the characteristics of many organizations. Such analysis might identify characteristics which *systematically* influence the extent to which computer technology is adopted and implemented.

Social scientists, in examining the adoption and implementation of new techniques and products like computers, normally classify them as "innovations." In fact, a major Rand study [34] has classified computers and EDP as one of the three generic types of technological innovations in local government.[1] Thus it is also interesting to ask whether there is anything unique or special about computers as a technological innovation. That is, *are the factors that influence the extent of adoption and use of computers different from the factors that influence other technological innovations?* This question is also considered in this paper.

These issues should be of interest to computer specialists because the analysis can provide illuminating information about the current state-of-the-art of computer use in American local governments. Moreover, the analysis will suggest that the level of computer use is importantly influenced by certain *political* features of the local government setting, despite the broad

assumption that computer technology is an apolitical tool. And it will be evident that the distribution of decision-making authority relating to EDP is clearly associated with the level of computer use. Those social scientists interested in the development of a richer foundation for innovation research should also find this study useful, since it contributes insights at both the empirical and the theoretical level.

1. Methods and Data

The research strategy in this paper is to create a measure of computer innovation in local governments, which is taken as the dependent variable (the characteristic whose variation across governments is to be explained). Several general streams of explanations for this variation in computer innovation are identified and summarized in the form of hypotheses. Operational measures for the explanatory (independent) variables are also specified. Then selected statistical analyses are employed to assess the nature of the relationships between computer innovation and the explanatory variables. In the analysis, municipal governments and county governments are treated as separate sets because the difference between these two kinds of governmental units, both in services provided and in organizational structure, lead to somewhat different associations with the factors influencing the level of computer innovation.

Some of the data utilized in this study are drawn from existing secondary databases, primarily U.S. census data for cities and counties. Other data are derived from a pretested, nationwide survey sent to the 403 U.S. cities with populations of 50,000 or more and to the 310 counties with populations of 100,000 or more. The survey consisted of self-administered questionnaires which were mailed to the appointed or elected chief executive and to the data processing installation(s) during the Spring of 1975.[2] The survey obtained a fine response rate—about 80 percent for each questionnaire in cities and about 70 percent for each questionnaire in counties.[3]

2. Computers as an Innovation

Victor Thompson [29] defines as innovation as ". . . the generation, acceptance, and implementation of new ideas, processes, products or services." Most studies now interpret "newness" to mean that the innovation is new to the organization which adopts it, rather than that it is relatively new in general. Thus other innovations for a local government might include a new sewage treatment system, the implementation of program budgeting techniques, helicopter patrolling by the police, and so on. Most innovation research has attempted to specify either the characteristics of an innovative organization or the pattern of diffusion for a particular innovation across organizational units [3, 15, 27, 28, 34].

Given the large number of different innovations which have been studied and the different conceptual frameworks of the researchers, there is a great deal of instability in the findings about the major characteristics of the truly innovative organization [11].[4] These characteristics tend to vary from the research on one innovation to the research on another. Some recent research has attempted to taxonomize public sector innovations in order to develop more generalized findings [3, 34]. But most of the research, constrained by the realities of the real world and by the practicalities of data gathering, continues to study one or a few related innovations. While this paper fits into the latter category of intensive study, it does consider how the findings about computer innovation are suggestive for understanding other technological innovations.

Examining the use of computers as an innovation is particularly intriguing. For local governments, it is clearly the recent innovation which has generated the most hope and which has affected the widest array of activities and procedures. In most of the larger governments, the administrative departments (especially the finance unit) and also the police make substantial use of computers. And in the more extensively automated cities and counties, virtually every department now has its own special automated applications. For every local government, the implementation of computer technology involves a rich and complex process rather than a simple decision to adopt. While the initial adoption decision is important, it is probably less critical than the stream of decisions which follow regarding the extent to which the government's operations are automated, the sophistication of the applied technology, and the ongoing allocation of resources to EDP. Thus EDP as an innovative technology is best conceptualized as a flow of implementation decisions through time. Our measure attempts to capture some of this complexity by incorporating values from five components of a local government's utilization of EDP.[5] Each component is discussed briefly.

2.1 Speed of EDP Adoption

While the dramatic expansion of EDP use in local governments has occurred since the mid-1960s, some governments had begun utilizing data processing systems in the late 1950s. Our indicator for the speed with which computer technology was adopted is the number of years (prior to 1975) that EDP services have been utilized by the government. The "average" city adopted computers in about 1966, and the "average" county adopted in about 1967 (Table I). Speed of adoption suggests both the rapidity with which the innovation was undertaken and also the potential time for penetration of the technology into organizational practice.

Table I. EDP Per Capita Investment, Speed of Adoption, and Range of Uses by City and County

EDP Innovation Indicator	Cities 50,000 and Over Mean	Standard Deviation	(N)	Counties 100,000 and Over Mean	Standard Deviation	(N)
Speed of EDP Adoption (Years since adoption)	9.11	5.23	(267)	7.98	5.48	(131)
Per Capita Investment in EDP	$2.68	2.18	(291)	$2.13	2.26	(180)
Range of EDP Uses (Number of Operational Applications)	31.33	22.72	(305)	32.31	21.63	(190)

Table II. Commitment to EDP by Cities and Counties

Level of EDP Commitment	Percent Indicating: Cities 50,000 and Over %	(N)	Counties 100,000 and Over %	(N)
1. No EDP	9%	(22)	14%	(22)
2. Less than .5% of budget	20	(50)	14	(23)
3. .5 - 1% of budget	39	(100)	18	(30)
4. 1 - 2% of budget	24	(61)	28	(45)
5. Over 2% of budget	9	(22)	26	(42)
TOTAL	101%	(255)	100%	(162)

2.2 Level of Commitment to EDP

While the sheer speed of adopting computers is important, many local governments purchase substantially different amounts of computer services, including service from other governments or private service agencies [9]. Thus our indicator of computer innovation distinguishes the extent of commitment to EDP, measured by the proportion of budgetary resources allocated to support computing services. Table II reveals that there is some variation in the financial commitment to EDP for both cities and counties. Most counties spend more than 1 percent of their operating budgets on computing, and the largest proportion of cities spend between .5 and 1 percent.

2.3 Per Capita Investment in EDP

An indicator of the ongoing support for data processing operations is the total amount of financial resources (per capita) allocated to EDP. This provides a means for comparing the relative investment of governments in EDP, and it is less dependent on the service mix of a government than is the commitment measure. Cities tend to spend more per capita on computer services than do counties (Table I).

2.4 Extensiveness of EDP Use

Our survey identified 258 activities of local government within which EDP might be utilized. This indicator is the number of currently operational computer applications for each government. Table I shows that in both city and county governments the average number of automated applications is more than 30. Moreover, there is substantial variation in the extensiveness of automation across governments (this is clearly evident in the very large standard deviation).

Table III. Sophistication of EDP Development in Cities and in Counties

Extent that Information Processing Tasks are Automated[a] Description	Percent in category: Cities 50,000 and greater %	(N)	Counties 100,000 and greater %	(N)
0. No EDP	10%	(33)	13%	(28)
1. No task automated[b]	8	(26)	4	(9)
2. One task	32	(105)	25	(53)
3. Two tasks	16	(53)	24	(51)
4. Three tasks	22	(72)	25	(53)
5. Four tasks	12	(40)	10	(21)
Total	100%	(329)	101%	(215)

[a] Number of types of "information processing tasks" with two or more applications operational.

[b] Government has EDP services provided, but no information processing task has at least two applications operational.

2.5 Sophistication of the EDP Development

The nature of computer innovation in a government can be assessed by the range of sophistication in the automated tasks. A simple indicator of sophistication is the proportion of four different types of "information processing tasks" within which at least two applications are operational. These tasks are: record-keeping, calculating/printing, sophisticated analytics, and process control. Broadly, each type of information processing task requires more sophisticated data processing technology (particularly software), and the 0-5 scale of sophistication tends to approximate a cumulative scale pattern.[6] Table III reveals that the governments are quite broadly distributed on this measure of sophistication in use.

The dependent variable in this paper, "EDP innovation," is a scale which is based on these five components characterizing the adoption of, commitment to, and use of EDP as an innovative technology for local governments. Table IV displays the intercorrelations among the component indicators for the cities and for the counties. Generally, these intercorrelations suggest that the innovation scale is quite representative of the phenomena measured by all the indicators.[7]

3. Theoretical Expectations

Literature on innovation in public bureaucracies and on computer technology in local government suggests several streams of explanations for EDP innovation. Broadly, these explanations correspond to four classes of variables which might account for innovative activity. These four streams focus upon the characteristics of the local political system, the community's "political culture" (that is, the politically relevant values and beliefs dominant in the community), the social and economic environment, and the external policy environment within which the political system

Table IV. Relationships among EDP Innovation Indicators, Cities and Counties[a]

Indicators	Investment: Data Processing Commitment	Investment: EDP Expenditures Per Capita	Speed: Years Having EDP	Output: Total Applications	Output: Sophistication of Uses	Summary Scale: Innovation Scale[b]
	CITIES					
Data Processing Commitment		.66**	.08	.26**	.58**	.90**
EDP Expenditures per Capita	.48**		.21**	.38**	.36**	.74**
Years Having EDP[c]	.16	.24**		.39**	.29**	.61**
Total Applications	.36**	.43**	.34**		.75**	.81**
Sophistication of Uses	.68**	.32**	.27**	.68**		.86**
Innovation Scale[b]	.83**	.73**	.61**	.83**	.88**	
	COUNTIES					

* P < .05

** P < .01

[a] Pearson correlations among cities in upper right, correlations among counties in lower left. The index is quite reliable for both cities and counties. Cronbach's alpha reliability coefficient equals .79 for cities and .77 for counties.

[b] The innovation scale is the sum of the standardized scores of each of the five components (times 10 and plus 50): data processing commitment, EDP expenditures per capita, years having EDP, total number of operational applications and sophistication of EDP uses. Factor analysis of the five components support a unidimensional representation. Eigenvalues within the city sample equal: 2.79, 1.00, .72, .40, .08; within the county sample, eigenvalues equal: 2.67, .90, .72, .62, .08. While the second highest eigenvalue for the city sample is the traditional 1.00 cutting point, scree tests, face validity, relationships of each component with outside criterion variables and the meaningfulness of alternative factor solutions argue for a unidimensional representation. The mean of the innovation scale for cities is 49.15 with a standard deviation of 8.40. The mean for counties is 48.58 with a standard deviation of 9.08.

[c] Years having EDP has the least shared variance with other components of this scale. Communality estimates for each variable are:

Variable	City Sample	County Sample
Commitment	.71	.72
EDP expenditures per capita	.65	.51
Years EDP	.19	.14
Total applications	.77	.75
Sophistication	.80	.82

operates. The central research question is to specify the critical attributes associated with those local governments more or less innovative in the adoption and use of computers. In this section, a broad range of exploratory hypotheses are specified and made operational on the basis of available research findings.

3.1 The Local Political System

Much of the literature suggests that organizational innovation is a response to characteristics of the organization itself. For a local government, these characteristics might include the structure of the organization, the decision-making processes within the organization, or the attitudes and values of key organizational actors.

Hypothesis 1. *Administrative reform*: EDP innovation is positively associated with the presence of an administrative reform orientation.

The local government reform movement was founded in the desire to transform the operations of local government into those of a professionally managed business. Administrative reformers, committed to greater efficiency and rationality in operations, might view EDP as a tool of great potential [15, 18, 23]. The operational indicators include both structural and behavioral indicators of a reform orientation. The structural indicators are three typical reform characteristics (the existence of a professional chief executive officer, nonpartisan rather than partisan elections, and at-large rather than ward elections to the local legislative body). Behavioral measures of reform are an index indicating the current use of professional management practices[8] and indices measuring the extent of control over EDP decisions by professional administrators or elected officials.[9]

Hypothesis 2. *Centralization of administrative decision making:* EDP innovation is positively associated with the degree of administrative centralization, particularly with respect to control of EDP.

It is sometimes argued that, to the extent decision-making power is decentralized, the capacity of an organization to maintain an innovative change is reduced [5, 16, 26, 34]. While power in local governments is less hierarchical than in many private organizations, varying levels of administrative centralization can be measured. The pluralism over EDP decisions (that is, the extent to which there are multiple control points) is measured by summing the standardized average influence on EDP decisions attributed by the chief executive to each of seven kinds of officials.[10] A second indicator measures decentralization of control by registering whether departments which use EDP services are involved in the design and programming of their own automated applications.[11] A broader indicator of administrative centralization is the number of city or county agency or department heads who are chosen by general election rather than by executive appointment. It is assumed that an increase in such independently elected officials reduces the likelihood of a centralized decision structure headed by the chief executive.

Hypothesis 3. *Management support for computing:* EDP innovation is positively associated with top management support for EDP.

Although policy decisions like the initial adoption of EDP typically depend on past decisions, our measure of EDP innovation captures the continuing stream of decisions about the development and implementation of computers in local government. Research suggests that continuing top management support is a central factor in the successful development of EDP [22, 34]. A summary scale is used to measure the attitudes of the chief executive and is based on a set of evaluative statements about EDP.[12]

3.2 The Local Political Culture

A second stream of explanatory variables views innovation in local government as a function of the community's values and group political life. Within the framework of systems analysis, it is assumed that political decision makers will be influenced by the kinds of demands and supports they receive from individuals and groups in the local environment. These local values have often been characterized in the research literature as the local "political culture." Thus it is posited that the attitudes toward EDP that are dominant in the local political culture might affect decisions on computer utilization.

Hypothesis 4. *Socioeconomic class support for EDP use:* 4(a): EDP innovation is positively associated with higher socioeconomic status in the community. 4(b): EDP innovation is negatively associated with the influence of private-regarding or ethnic groups in the community.

The broad inference from a political culture perspective is that different socioeconomic class configurations will generate different patterns of demands and supports for the use by local government of a technological innovation like EDP. It is assumed that these different policy preferences are somehow aggregated and translated into policy decisions by the local government.[13] This inference has several variations. First, research has established that favorable public attitudes toward various technologies, and computers in particular, are substantially higher among higher socioeconomic strata [1, 34]. Second, "ethos theory" [31, 32] suggests that higher social class groups tend to support programs which benefit, as does the extensive use of EDP, the general community rather than specific groups. Conversely, certain ethnic groups (e.g. blacks and most "hyphenated-American" groups) are characterized as "private-regarding," since they are believed to support programs which allocate resources directly to their members. Higher socioeconomic status is measured by a scale which includes occupational, income, and educational components.[14] The chief executive's appraisal of the reputed influence in local politics of various groups classified as private-regarding is used to indicate the relative importance of a private-regarding ethos,[15] and measures of the proportion of the population which is of ethnic stock or black are employed to indicate ethnic group presence.

Hypothesis 5. *Heterogeneity of group political life:* EDP innovation is negatively related to the heterogeneity of group political life.

Most research [4, 17; but see 2] suggests that the diffusion of group influence among a heterogeneous array of community groups constrains the process of change or innovation, presumably because there are more veto groups. An indicator of the pluralism of community group influence is constructed on the basis of the chief executive's perceptions of the influence on community political decisions of 14 kinds of groups.[16]

3.3 Social and Economic Environment

The third explanatory stream regarding EDP innovation also takes a system perspective. According to this explanation, local government decisions are primarily a response to major environmental forces. In its most extreme form, this might be termed environmental determinism, since governmental outputs seem to be driven by the imperatives of the environment and only marginally altered by variations in the internal characteristics of the local political system.

Hypothesis 6. *Size and complexity of the environment:* EDP innovation is positively associated with the relative need for EDP—as measured by population size, growth rate, and land area.

The physical aspects of the environment served by the political system might generate different levels of need for the use of EDP as an innovative technology. As population size, population growth rate, or land area increase, the scope and complexity of a government's information processing environment increase and the potential utility of automation is expanded. For example, EDP has the capacity to handle the very large amounts of data and large numbers of files that are required to manage a large population. Moreover, as the population increases, the computer can handle the increased information needs with only a marginal expansion in requirements (relative to the handling of the same needs through expansion of personnel and manual filing systems). And the remote hardware of third generation computers allows files to be stored in a central location but accessed by any number of terminals located throughout a large geographic area.

Hypothesis 7. *Region:* The extent of EDP innovation varies significantly among regions.

A common finding in research on organizational innovation is that regional patterns of diffusion develop. The work of Rogers and others [25, 27, 34] suggests that communication networks of adopters and potential adopters exist and that many organizations tend to follow the initiatives of their reference group leaders. Other research and our research on EDP [19, 30] suggest that the communication networks for local government innovation are typically regional. Thus it is hypothesized that local governments will stimulate and reinforce each other in the adoption and continued development of EDP technology more actively in some regions than in other regions. Our indicator examines the relationship between EDP innovation and each of the four major regions (Northeast, North Central, South, and West), employing four dummy variables (that is, Region A or Not Region A, and so on.)

Hypothesis 8. *Local financial resources and wealth:* 8(a): EDP innovation is positively associated with greater local government financial resources. 8(b): EDP innovation is associated with local government environments where needs outstrip financial resources.

The relationship between the wealth of a local government and its use of an innovation like EDP is rather complex. One hypothesis, supported by various studies of innovation in the public sector, is that units with greater economic resources are more capable of supporting a costly innovation like a large EDP operation. This might be termed the "slack resources" explanation of EDP innovation [25, 34]. Alternatively, the literature suggests a "problem-solver" explanation of innovation [34]. In this view, the very lack of available resources stimulates the search for innovative procedures or technologies that are expected to be cost-effective. To the extent a "performance gap" [10] is perceived between financial resources and needs, a local government might view EDP use as a response.[17] Operational measures of financial resources are the quality of the local bond rating, per capita income, and the percentage of families below the poverty level. The first two seem better indicators of the existence of slack resources, and the third might signify a political environment where substantial needs are likely to strain available resources.

3.4 External Policy Environment

Although EDP development is essentially a local decision, it might be responsive to the external policy environment.

Hypothesis 9. *External funding support for EDP:* EDP innovation is positively associated with the presence of external funding support for EDP.

External governments, particularly federal agencies and departments, have experimented with a variety of forms of assistance for local government EDP.[18] Most of these interventions by federal and state agencies have primarily been direct financial support for hardware, software, or personnel development. Our measure is whether outside funding support (specifically for EDP) was received in the year prior to the survey.[19]

4. Findings

In this section, the hypotheses are initially evaluated on the basis of the statistical association between each independent variable and the EDP innovation scale. Because population size has a strong statistical association with EDP innovation and because population is a critical variable in many cross-sectional analyses of the determinants of public policy, it is particularly appropriate to select population size as a controlled third variable. Table V displays the zero-order correlation coefficients and also the first-order partial coefficients (controlling for population) for both cities and counties.[20]

4.1 EDP Innovation and the Local Political System

Hypothesis 1. *Administrative reform.* In general, the findings are suggestive that a local political system characterized by an administrative reform orientation is likely to adopt computer technology more fully. The reform structures of a professional chief executive and of nonpartisan elections are clearly associated with EDP innovation, but the use of at-large elections has no association with EDP innovation in cities and is negatively correlated with it in counties. Among the behavioral measures of reform, the data suggest that greater administrative official control of EDP and/or less elected official control of EDP occur where EDP innovation is greater. And EDP innovation coexists with other professional management practices, partic-

Table V. Relationships between EDP Innovation Scale and Hypothesized Independent Variables, Cities and Counties

Categories and Indicators	Cities r	Cities r Controlling Population	Cities (n)	Counties r	Counties r Controlling Population	Counties (n)
A. LOCAL POLITICAL SYSTEM						
REFORM STRUCTURE						
Professional chief executive	.17**	.22**	(276)	.27**	.25**	(177)
Non-partisan elections	.18**	.21**	(270)	.21**	.24**	(175)
At-large elections	.01	.08	(269)	-.13*	-.10	(166)
Professional management practices	.25**	.19**	(271)	.09	.02	(173)
Central administrative control of EDP	.01	.03	(262)	.26**	.18**	(156)
Elected official control of EDP	-.25**	-.29**	(259)	-.17*	-.17*	(162)
CENTRALIZATION						
Pluralism of EDP decisions	.26**	.27**	(329)	.23**	.24**	(217)
Department user control of EDP design	.04	-.02	(232)	.27**	.28**	(153)
Number of other elected officials	-.11*	-.10	(273)	-.06	-.04	(164)
SUPPORT						
Chief executive support	.08	.09	(274)	.19**	.12	(175)
B. LOCAL POLITICAL CULTURE						
SOCIAL CLASS						
Socio-economic status scale	.21**	.29**	(316)	.31**	.23**	(217)
NATURE OF GROUP POLITICAL LIFE						
Percentage foreign stock	-.21**	-.20**	(316)	.12*	-.04	(217)
Percentage black ($\log_{10}$)	.21	.07	(250)	.14*	.07	(207)
Private regarding group influence	.05	-.10*	(267)	.18**	.06	(169)
GROUP HETEROGENEITY						
Pluralism of group influence	.07	-.04	(268)	.06	.01	(170)
C. SOCIAL-ECONOMIC ENVIRONMENT						
SIZE AND COMPLEXITY						
Total population ($\log_{10}$)	.46**	--	--	.39**	--	--
Total land area	.19**	-.06	(316)	.32**	.28**	(217)
Population growth	-.10	-.10	(324)	.29**	.30**	(215)
REGION						
Northeast	-.17**	-.13**	(329)	-.29**	-.32**	(217)
North Central	-.08	-.11*	(329)	-.22**	-.21**	(217)
South	.20**	.17	(329)	.12*	.15**	(217)
West	.12**	.15**	(329)	.46**	.44**	(217)
ECONOMIC RESOURCES						
Quality of bond rating	.25**	.24*	(133)	.03	.03	(127)
Per capita income	.08	.12	(316)	.27**	.11	(217)
Percentage families below poverty level	.08	.00	(316)	.00	.08	(217)
D. EXTERNAL POLICY ENVIRONMENT						
OUTSIDE FINANCING						
Presence of outside funding	.25**	.15**	(230)	.20**	.17*	(137)

*P<.05
**P<.01

ularly in cities. Thus Hypothesis 1 is generally supported by the data, and controlling for population size has minimal impact on the findings.

Hypothesis 2. *Centralization of administrative decision making.* Measures of general centralization of top management are not particularly related to EDP innovation. Contrary to the expectation that EDP innovation would be greater where there was greater centralization of administrative decision making, those governments are most innovative where there is greater pluralism of EDP decision making and control. Given the cross-sectional nature of the data, a causal explanation is problematic. It might be that most innovative activity occurs at the departmental and agency level, in which case decentralization of authority relating specifically to EDP might create a climate particularly conducive to expanded development and use of the technology [14]. Or it might be that more extensive EDP activity has itself stimulated broader participation in EDP decisions and greater user involvement. Whatever the sequence of effects, the data do not support the notion that centralization stimulates innovative activity. There is no obvious explanation for the city/county difference in the association of EDP innovation with user control.

Hypothesis 3. *Management support for computing.* Contrary to the conventional wisdom that top management support is critical, there is only a weak association between chief executive support for computing and EDP innovation, and this is even further reduced when population size is controlled.

4.2 Local Political Culture

Hypothesis 4. *Socioeconomic class support for EDP use.* The variation of the hypothesis (4(a)) which posits greater EDP innovation where the higher socioeconomic strata are a larger proportion of the population is clearly supported, even when population size is controlled. When population is controlled, there is some evidence that larger proportions of "private-regarding" groups are associated with lower levels of EDP innovation in cities, but there is no support for the "ethos" hypothesis (4(b)) in counties. Moreover, there is a slight positive association in both cities and counties between the size of the black population and EDP innovation, when population is controlled. Given these mixed findings, the hypothesis is insufficiently supported.

Hypothesis 5. *Heterogeneity of group political life.* There is virtually no relationship between the pluralism of group influence in the community and the level of EDP innovation.

4.3 Social and Economic Environment

Hypothesis 6. *Size and complexity of the environment.* The correlations between EDP innovation and the population size, land area, and recent growth rate are among the strongest in Table V. Among the dependent variables in the analysis, population size has the highest statistical association with EDP innovation in cities and has the second strongest association in counties. When population is controlled, land area and growth rate continue to have strong positive associations with EDP innovation in counties, but the relationship with city land area is reduced substantially. A somewhat perplexing finding is the negative association between city growth rate and EDP innovation, since the capabilities of computers seem particularly suited to an expanding government and population. With the exception of this anomaly, the data suggest that the use of computers by local governments increases where the human and, in counties, the physical environments are of greater scope and complexity.

Hypothesis 7. *Region.* There is substantial regional variation in the level of EDP innovation in cities and particularly in counties. The western and southern states are the most active in the adoption and development of local government computing. The northeastern and north central states are least active. The regional variations remain very strong in counties when population is controlled, although this control reduces the regional differences in cities. These regional variations might be attributed in part to the impact of "social

interaction networks" [34], which generate different levels of both consciousness about EDP and interpersonal communication of support for use of the technology. While our data do not determine the underlying dynamics of the regional differences, these differences are quite distinct.

Hypothesis 8. *Local financial resources and wealth.* The simple associations between measures of slack financial resources (Hypothesis 8(a)) and the EDP innovation index are quite inconsistent across cities and counties. The quality of the bond rating is substantially associated with higher levels of EDP in cities, but city per capita income is not. In the counties, it is per capita income rather than bond rating that is correlated with EDP innovation. Controlling for population size eliminates the positive finding in counties, leaving only the correlation between city bond rating and EDP statistically significant. While the bond rating seems a quite valid measure of economic viability and slack resources, fewer than one-half of the local governments have an established bond rating, and it might involve an unrepresentative subset of cities. Thus the slack resources hypothesis for EDP innovation in either cities or counties remains plausible but is best interpreted as not supported by these findings. The problem-solver hypothesis (8(b)) is slightly supported in the positive correlation between poverty-level families and EDP innovation, when population is controlled. But these associations are weak, and this hypothesis also remains plausible but insufficiently supported.

4.4 External Policy Environment

Hypothesis 9. *External funding support for EDP.* The presence of state or federal funding support for computing is positively associated with EDP innovation in both cities and counties. It is likely that there is an interactive effect between higher levels of outside funding and of EDP innovation. Most outside funding is awarded on a competitive basis, and field research suggested that more extensively automated governments were more likely to apply for such funding and thus might also be more likely to be rewarded by the granting agencies.

5. Computers as a Technological Innovation

In the more recent studies of innovations, there has been increased recognition that innovations do not form an undifferentiated class of phenomena. Rather, there are likely to be key dimensions that are related to a particular innovation in its unique context [14]. Our findings suggest that four general categories of variables are associated with computers as a technological innovation in American local governments.

First, it is evident that certain characteristics of the environment can affect the level of the innovation. However, *the impact of the environment is contingent upon the functional capabilities of the particular innovation.* Given the current functional capabilities of EDP hardware and software in local governments, several environmental factors seem to influence the level of benefit from EDP. The virtues of EDP over manual systems clearly increase with the increasing volume and complexity of the data to be processed. The record-keeping and calculating/printing information processing tasks were the initial automated applications in most local governments, and they still constitute a substantial majority of the operational applications [9]. Thus the major environmental imperatives which relate to the capabilities of this particular innovative technology are those factors that reflect the sheer scope and complexity of the organization's information processing environment. For local government, this scope and complexity is indicated by the number of citizens served, the rate at which the citizen population is increasing, and the extensiveness of the land area that must be served.

Secondly, it is also important to *specify those factors which might facilitate the adoption and development of the innovation.* Regarding EDP, there are many energetic entrepreneurs and vendors prepared to supply hardware, software, and skilled personnel resources, given sufficient payment. Given that supplier activity is generally high, one would expect that adequate financial resources is one critical factor facilitating EDP development. It is difficult to make useful distinctions about financial capacity to support EDP innovation, since "slack financial resources" is a relative notion embedded in resource allocation decisions based on opportunity costs [34]. The data do suggest that the slack indicated by outside funding to cities and counties and possibly by our indicators of greater internal financial resources in cities are associated with higher levels of computer innovation.

Among the other factors that might facilitate the expansion of local government EDP innovation, a supportive environment could be important. This might involve either a favorable climate of local opinion regarding use of the innovation or evidence of more extensive acceptance and use of the innovation by proximate local governments. The data are consistent with these expectations, since EDP innovation varies with the proportions of local class strata expected to be more or less supportive of EDP technology and since some regions are substantially more active in EDP innovation than others.

The third and fourth categories of variables that seem related to EDP innovation in local government are premised upon the essential fact that the intraorganizational context of the innovation is *political*. It is surprising that many studies treat innovations in the governmental sector as apolitical phenomena. Yet most innovations in government have at least the potential to cause shifts in the distribution of values and rewards among various actors and interests. And, as Yin et al.

[33] note, EDP innovations might serve the bureaucratic self-interest of some local government actors. Thus an explanation of the variation in adoption and development of an innovation in government ought to be grounded in a careful specification of its political implications. Hence the third and fourth categories of variables address classic political issues: Whose interests and values are best served by the innovation? Who controls key decisions regarding the innovation?

For many innovations, the question of *whose interests and values will be primarily served* is contingent upon the skills and agendas of competing political actors. In general, however, the interests and values served by local government computing are relatively clear [23, 12]. Essentially, EDP has served the agenda of the bureaucratic personnel, particularly those in administrative positions, far more than it has served those of elected officials, the citizen public, or operating personnel. The great majority of applications serve administrative functions, even in those departments and agencies which directly serve the citizens [9]. While elected officials and citizens undoubtedly receive indirect benefits from certain applications that are cost-effective or operationally efficient, EDP has been primarily a tool by which administrators increase their control over information, operations, and personnel. More broadly, current EDP use most fully complements the orientation that government should operate like a professionally run business. These considerations about the interests and values served by current use of the technology lead to the inference that EDP innovation will tend to be associated with intraorganizational contexts dominated by the professional values of the reform orientation to government. The data support this expectation, since EDP innovation is associated with the structures and practices of political reform and professional management.

The issue of *decisional control over the innovation* is closely related to the question of interests and values. To the extent that those whose values are served by the technology are also those who control key decisions regarding its adoption and use, one would expect higher levels of adoption and use. The data have shown that EDP innovation tends to be greater where control of EDP decisions is distributed toward those groups who derive the most substantial benefits from EDP technology—toward central and departmental administrators rather than toward elected officials—and where private-regarding community groups seem to be a less potent political force.

The importance of these four categories of variables seems to be supported by the pattern of associations reported in Table V. However, a shortcoming of the analysis is that it is not sensitive to the interdependencies among the explanatory variables. The relative importance of the variables can be estimated by the use of multivariate techniques. In Table VI, a variable is included in the analysis if, in an exploratory regression analysis, its regression coefficient was at least twice its standard error. The table reports those variables which achieve this criterion (for cities and for counties) as a cumulative multiple correlation.

In general, these findings clearly support the general categories of explanatory variables presented above. There is substantial similarity between the variables for EDP innovation in cities and in counties. First, the environmental constraints affecting the functional utility of the technology, size and complexity, are represented by population size. Second, the facilitating factors of region and outside funding support have positive relationships with both city and county EDP innovation. However, the impact of the local opinion climate, indicated by measures of socioeconomic status in the community, is not sufficient for inclusion in the regression analysis.

Third, the analysis supports the view that EDP innovation is linked to the interests and values of the professional, reform government orientation (represented by the existence of a professional chief executive in counties and by the use of professional management practices in cities). Finally, the regressions are consistent with the notion that decisional control over EDP is important. Use of the technology is positively influenced by increased control of EDP by administrators (as represented by the indices of pluralism of EDP decision control and user department control over EDP) and is negatively influenced by increased control of EDP by elected officials. In sum, the results are quite consistent with an explanation of intergovernmental variation on EDP innovation based on critical environmental constraints, facilitating factors, intraorganizational interests and values served, and decisional control.[21]

6. Summary and Conclusions

This study has attempted to identify the major characteristics that explain why some local governments are more or less active in the adoption and use

Table VI. Cumulative Multiple Correlations between Selected Independent Variables and EDP Innovation in Cities and Counties[a]

Independent Variables	Direction	Multiple R	Multiple R^2	Increase in R^2
CITIES				
Total population (log_{10})	+	.46	.21	.21
Elected official control	-	.52	.28	.06
Pluralism of EDP decisions	+	.57	.32	.05
Southern & Western U.S.[b]	+	.59	.35	.02
Professional management practices	+	.61	.37	.02
Presence of outside funding	+	.62	.38	.01
COUNTIES				
Southern & Western U.S.[b]	+	.46	.21	.21
Total population (log_{10})	+	.60	.36	.15
Departmental user control	+	.64	.41	.05
Presence of outside funding	+	.66	.43	.02
Professional chief executive	+	.67	.45	.02

[a] Variables were entered with independent regression coefficients at least twice their standard error.

[b] Coded as: South or West = 1; Northeast or North Central = 2.

of computers as an innovative technology. A dependent variable of computer innovation has been developed. It characterizes the speed with which electronic data processing was adopted and the commitment to, extensiveness of, and sophistication of EDP.

Initially, the examination was organized in terms of alternative streams of theoretical explanation for innovative behavior in the public sector. In general, a higher level of computer innovation was found to be statistically associated with local governments[22]:

(1) which serve a larger population and a greater land area;
(2) in the western and southern regions as opposed to the northeast and north central regions;
(3) whose local political systems have attributes of the professional, reform orientation to local government;
(4) with greater decentralization of decisions regarding EDP;
(5) whose populations have a larger proportion of higher socioeconomic strata; and
(6) which receive outside funding support for EDP.

By employing analytic methods which account for the interactive effects among explanatory variables, the most important variables have been identified. The analysis suggests a model of computer innovation in a political environment. There are four general categories of variables which seem to affect the intergovernmental variations in the use of computer technology:

(1) Environmental factors which constrain the functional utility of the innovation—computer innovation grows with increasing size and complexity of the information processing environment, as indicated by population size.
(2) Factors which facilitate the adoption and use of the innovation—computer innovation increases with the synergistic effect of a region that is relatively more innovative in EDP use and with the presence of external funding support for EDP.
(3) The array of interests and values served by the innovation—computer innovation is higher where the values of professional management and reform government are more dominant.
(4) The level of decisional authority distributed to those whose values are served by the innovation—computer innovation is higher where central and departmental administrative officials (rather than elected officials, operations personnel, or citizen groups) have greater control over EDP decisions.

Clearly, much of the between-government variation is not accounted for by the variables employed here. In both cities and counties, the optimal combination of independent variables "explains" (measured statistically in Table VI as the multiple R^2—the "fraction of explained variance") less than 50 percent of the variation. It is our view, on the basis of numerous case studies, that a full explanation of differences in local computer development would also entail particularistic factors that cannot be readily tapped by large-scale data collection efforts. However, despite such local differences, this analysis encourages us that a reasonable explanatory model for this technological innovation can be developed.

Most computer specialists and social scientists would probably share the assumption that decisions about the adoption and expansion of computer technology among local governments are far from random. And this analysis has clearly shown that the commitment to computers is contingent upon the systematic impact of certain characteristics which make computer use more or less attractive to the government. As might be expected, the scope of the government's information processing needs and outside funding for computing facilitate more developed systems. But it is intriguing that different value systems among local officials and different styles of distributing control over the computer system also have clear effects on the level of computer innovation.

More concretely, those involved with local government computing might derive other interpretations from these findings. To some extent, the level of computer innovation seems to be constrained by certain forces about which local decision makers are likely to have little awareness. But those interested in expanding computer usage might note that use is higher where administrative officials and user departments have greater authority over EDP decisions and where elected politicians have less authority. Moreover, it is surprising that the level of support for computers expressed by the chief executive is virtually unrelated to the level of computer innovation. Federal agencies might conclude that direct funding has had some stimulative effects on those local governments receiving grants for EDP. Opportunistic vendors might decide that the most receptive markets for their products are in the South and West and in governments oriented towards professional management; but entrepreneurial vendors might decide that the markets in the Northeast and North Central states offer the most potential for development. And all might ponder why computers, purportedly an apolitical technology, are adopted and expanded at quite different rates in milieus characterized by alternative configurations of political values and interests.

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Notes

1. The other two types are hardware innovations and data analysis innovations [34].
2. Specific recipients of the chief executive questionnaire were mayors in mayor-council cities, managers in council-manager cities, chairpersons in commission cities and counties, elected county executives in counties with a single elected executive, and chief administrative officers in counties which have such an office designated.

3. The chief executive questionnaire was returned by 82 percent of the cities and 77 percent of the counties. The two questionnaires mailed to data processing managers were returned by 81 percent of the cities and 68 percent of the counties using EDP.

4. Even the integrative findings in the Rand study [34] seem best interpreted as underlining the lack of consistent empirical relationships across various studies of innovation.

5. It should be noted that while we use a summary measure of EDP innovation, our analysis corresponds to Downs and Mohr's [11, p. 706] "innovation-decision design" for a single type of innovation. In general, we agree with their advocacy of single innovation studies which do not aggregate disparate types of innovations into a summary measure for the organization. Moreover, our independent variables include secondary attributes of the innovation (that is, how the innovation is perceived by the organization) as well as primary and secondary attributes of the organization.

6. Measures of fit for the sophistication scale components, relative to an ideal cumulative pattern, are: coefficient of reproducibility, .93; minimum marginal reproducibility, .76; coefficient of scalability, .71. This index was first developed by Dutton and Kraemer [12]. For discussion of the information processing task, see [7].

7. In particular, the scale is the average standardized score (that is, it has a mean of zero and a standard deviation of 1.0) over each of the five components. Factor analysis of the five components also supports a unidimensional representation (Table IV). Most importantly, separate analyses of the correlates of innovation using the individual components, rather than the innovation scale, support the same theoretical generalizations which are reported in this paper. This is true even for years having EDP, despite Downs and Mohr's view that the decision to adopt should be treated as conceptually independent of the decisions regarding implementation [11:710]. While this position is reasonable (and years since adoption has the lowest shared variance with the other components), the findings in our analysis were virtually unchanged when adoption was treated separately. For simplicity and for richness of the index, the year of adoption has been retained in the dependent variable.

8. Chief executives were asked to respond with rough proportional estimates to the following: "Do departments and agencies within your local government establish written objectives for the programs and services they provide?" "Does the chief executive see measures of performance in meeting the objectives of these programs?" Coded: 1 = no explicit objectives; 2 = some programs have written objectives but few performance measures; 3 = some programs have written objectives and half or more have performance measures; 4 = nearly all programs have written objectives but few have performance measures; 5 = nearly all have written objectives and performance measures.

9. The "central administrative control" index represents the number of the following criteria which were met: (1) Executive "strongly agrees" that "decisions about the expansion of data processing facilities and services are generally made by the chief executive, although others may initiate the request"; (2) in governments with an EDP policy board, recommendations of the board are made to the chief appointed official; (3) in governments with an EDP policy board, the chief executive's office is represented on the board; and (4) executives believe it is "extremely likely" that the chief appointed official and staff will have a major input in a decision related to data processing, such as introducing computers to help perform a task. The number of criteria met was divided by the number of criteria applicable to that government.

The "elected official control" index represents the number of the following criteria which were met: (1) In governments with an EDP policy board, the policy board recommends actions to the chief elected official; (2) the policy board recommends actions to the legislative body; (3) the legislative body is represented on the policy board; (4) the chief elected official and/or (5) the legislative body is "extremely likely" to have a major input in a decision related to data processing, such as using computers to help perform a task.

10. The seven are: (1) chief elected official and staff, (2) chief appointed official and staff, (3) local legislative body, (4) data processing manager(s), (5) department heads, (6) department line personnel, (7) interdepartmental committees. They were rated on a scale of 1 = not likely to have a major input into the final decision, 2 = somewhat likely, 3 = quite likely, and 4 = extremely likely.

11. The user control index is coded: 0 = users have not programmed or designed applications within the last two years; 1 = have programmed or designed applications; 2 = have programmed and designed applications within the last two years. Responses were obtained from data processing managers.

12. This scale sums the standard scores of chief executives' responses to the following items rated from strongly agree to strongly disagree: (1) "The computer is an essential tool in the day-to-day operations of this government"; (2) "in the future, the computer will become much more essential in the day-to-day operations of this government"; (3) "computing and data processing have generally failed to live up to my original expectations" (reversed); (4) "in the future, a larger proportion of this local government's budget should support computers and data processing"; (5) "I have indicated to department heads that computers and data processing should be used wherever economically feasible in this government." This chief executive support scale is the summed score of each chief executive on each item such that high scores on the index represent high levels of support.

13. Some studies of policy outputs [6] question whether such an aggregation of individual preferences is operative.

14. The socioeconomic status scale is the sum of the following standardized variables: percent employed in managerial and professional positions, percent of families with incomes over $25,000; median school years completed, and percent of persons 21 years of age and over who have completed four or more years of college. With the exception of median school years, the other indicators are biased toward measuring high social strata.

15. As the lengthy community power debate documents, measures of political influence are exceedingly difficult to attain. We are clearly limiting our measures to "reputational influence" and recognize that valid assessments of influence require a combination of decisional, reputational, and positional methods of analysis. Chief executives were asked, "Overall, how would you rate the influence of each of the following groups in your community's politics?" The groups were: labor unions, minority groups, ethnic groups, and neighborhood groups. Ratings were scored from 1 = not influential to 4 = extremely influential. The scale is the summed ratings of the groups composing the scale.

16. This scale is also based on the following question to chief executives: "Overall, how would you rate the influence of the following groups in your community's politics?" The chief executive rated the level of influence for the following list: newspapers; bar association; local medical groups; labor unions; minority groups such as Blacks, Chicanos, Puerto Ricans; other ethnic groups; neighborhood groups; church leaders; Chamber of Commerce; industrial leaders; building and real estate people; bankers and executives of other financial organizations; good-government organizations; environmental, ecology groups. The scale is based on the average summed score across all groups for each city and county over all nonmissing responses.

17. In this study, the scarce resource notion of performance gap is employed. Another conceptualization would involve a gap in information processing capacity. But there were no direct, reliable indicators of an operational gap (e.g. bits of data per employee) or of a "useful information" gap.

18. These forms of assistance are discussed in [21]. Unlike many other local government innovations studied [15], EDP introduction and development has not been powerfully mediated through federal or state agencies.

19. Available figures of actual amounts received from outside sources were deemed too unreliable to be used. The dummy variable includes federal or state sources and the direct application of federal revenue-sharing monies. The level of outside financial support for EDP over a longer time period would be a more satisfactory measure but is not available.

20. There is controversy concerning whether tests of statistical significance are superfluous when the sample size approaches the population [24, 33]. Our sample fits this situation. We report levels of significance to aid in the interpretation of correlation coefficients and to place added emphasis on those statistical associations that are quite substantial, given sample size and possible measurement error.

21. These analytical points are more fully developed in [8].

22. This analysis differs from many policy analyses by considering both cities and counties. Counties are typically ignored for a variety of reasons, including a belief that there exist systematic differences between cities and counties which make comparative analyses suspect. Interestingly, this study suggests that in regard to EDP innovation there are more similarities than differences between cities and counties in the factors accounting for EDP innovation. But there are sufficient variations in the findings to convince us that independent analysis of cities and counties is reasonable.

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Professional Activities
Calendar of Events

ACM's calendar policy is to list open computer science meetings that are held on a not-for-profit basis. Not included in the calendar are educational seminars institutes, and courses. Submittals should be substantiated with name of the sponsoring organization, fee schedule, and chairman's name and full address.

One telephone number contact for those interested in attending a meeting will be given when a number is specified for this purpose.

All requests for ACM sponsorship or cooperation should be addressed to Chairman, Conferences and Symposia Committee, Dr. W.S. Dorsey, 1209 N. Reidel Ave., Fullerton, CA 92631, with a copy to Louis Fiora, Conference Coordinator, ACM Headquarters. For European events, a copy of the request should also be sent to the European Regional Representative. Technical Meeting Request Forms for this purpose can be obtained from ACM Headquarters or from the European Regional Representative. Lead time should include 2 months (3 months if for Europe) for processing of the request, plus the necessary months (minimum 2) for any publicity to appear in *Communications*.

Events for which ACM or a subunit of ACM is a sponsor or collaborator are indicated by ■. Dates precede titles.

In this issue the calendar is given to June 1978. New Listings are shown first; they will appear next month as Previous Listings. A full listing is in the November 1977 Communications.

NEW LISTINGS

30 January-2 February 1978
Ninth Southeastern Conference on Combinatorics, Graph Theory and Computing, Florida Atlantic University, Boca Raton, Fla. Sponsor: Florida Atlantic University. Conf. dir: Frederick Hoffman, Dept. of Mathematics, Florida Atlantic University, Boca Raton, FL 33431; 305 395-5100 X2758.

13-17 February 1978
■ **2nd International Learning Technology Congress and Exposition,** Orlando, Fla. Sponsor: Society for Advanced Learning Technology in cooperation with ACM SIGCUE. Conf. chm: David Kniefel, Director of Academic Services, New Jersey Computer Network, Box 390, New Brunswick, NJ 08903; 201 932-8070.

16-17 February 1978
National Conference on Information Systems Development, Doubletree Inn, Tucson, Ariz. Sponsor: University of Arizona. Contact: B. Konsynski or M. Loomis, Dept. MIS, ECON 403, University of Arizona, Tucson, AZ 85721; 602 884-3116.

3-4 April 1978
8th Annual Pattern Recognition Symposium, NBS, Gaithersburg, Md. Sponsors: NBS, EIA. Contact: Leslie Santacroce, Electronic Industries Association, 2001 Eye St., NW, Washington, DC 20006.

12-14 April 1978
Fourth Annual Asilomar Workshop on Microprocessors, Pacific Grove, Calif. Sponsor: IEEE-CS Western Area Comm. Gen. chm: Ted Laliotis, ASI, Inc., 840 Del Rey Ave., Sunnyvale, CA 94086; 408 739-6700.

11-12 May 1978
■ **First Annual SIGIR Conference,** Rochester, N.Y. Sponsor: ACM SIGIR. Conf. chm: James Iverson, Manager, Information Sciences, Xerox Square, 128, Rochester, NY 14644; 716 422-3016.

1-2 June 1978
Simulation, Modeling, and Decision in Energy Systems, Montreal, Canada. IASTED. Contact: M.B. Carver, Atomic Energy of Canada Ltd., Chalk River, Ontario K0J 1J0, Canada.

6-8 June 1978
Personal Computing Festival, in conjunction with 1978 National Computer Conference, Anaheim, Calif. Sponsor: AFIPS. Chm: Jim C. Warren Jr., Star Route Box 111, Redwood City, CA 94062; 415 851-7664.

12-13 June 1978
Symposium on Microcomputer-Based Instrumentation, NBS, Gaithersburg, Md. Sponsors: NBS, IEEE-CS, IEEE Group on Instrumentation and Measurement. Contact: Helmut Hellwig, NBS, Room A-1002 Administration, Washington, DC 20234; 301 921-3181.

15 June 1978
17th Annual Technical Symposium, "Tools for Improved Computing in the 80's," NBS, Gaithersburg, Md. Sponsors: ACM Washington, D.C. Chapter, NBS. Prog. chm: Bryce Elkins, Computer Sciences Corp., 400 Army-Navy Drive, Arlington, VA 22202.

18-20 July 1978
AI Conference, Hamburg, West Germany. Sponsors: AISB, Gesellschaft für Informatik. Local chm: H.-H. Nagel, Institut für Informatik, Universität Hamburg, 2000 Hamburg-13, Schluterstrasse 79, West Germany.

13-15 September 1978
■ **Fourth International Conference on Very Large Data Bases,** Berlin, Germany. Sponsors: ACM SIGMOD, SIGIR, SIGBDP, IEEE-CS, SMIS, IFIP. Gen. conf. chm: Herbert Weber; European chm: Claude Delobel; U.S. chm: Anthony I. Wasserman, Section of Medical Information Science, Room A-16, University of California, San Francisco, CA 94143; 415 666-2591.

21-23 September 1978
International Conference on Interactive Techniques in Computer Aided Design, Palazzo dei Congressi, Bologna, Italy. Sponsors: ACM Italian Chapter, IEEE-CS, AICA Working Group on Design Automation, and other organizations, under patronage of the University of Bologna. Gen. chm: Giorgio Valle, Istituto di Elettronica, Faculta di Ingegneria, Universita di Bologna, Viale Risorgimento 2, 40136 Bologna, Italy.

(Calendar continued on p. 966)