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The Federal Push to Bring Computer Applications to Local Governments*

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■ This paper assesses the impacts and effectiveness of federal policy for the diffusion of computer applications among local governments. Federal policies toward application diffusion are described along three dimensions—objectives, design approaches, and transfer mechanisms. These policies are examined in light of findings from six recent empirical studies about the processes which lead to the diffusion of computer applications. The assessment reveals that none of the present federal design approaches or transfer mechanisms seem to be working very well. Alternatives that merit consideration are suggested by the research.

Introduction

Federal officials concerned with science and technology policy have advocated the diffusion of technological innovations as means for improving the payoffs from R&D investments.[1] Both federal and local officials view the local government sector as an area for major payoffs from technological innovations aimed at improving productivity.[2] Since local government is highly labor-intensive, they hope that significant productivity improvements can be achieved by replacing labor with capital investments in technology. This hope is illustrated by federal policy for the development of electronic data processing (EDP) among local governments.[3]

This paper evaluates federal policy for support of local EDP in light of our recent research findings regarding what leads to the diffusion of computer applications among local governments. First, we provide a description of federal activities toward the development of EDP in local governments as a model of the policy context of application diffusion. Second, we identify some of the features which contribute to diffusion of computer applications among local governments. These are the processes federal policy is designed to influence. Third, we assess the match between policy and process in seeking to determine the effectiveness of federal policy.

Federal Policy Towards Local Government EDP

Although there is no single coordinated federal policy for local EDP, there is substantial federal investment in local EDP,[4] and there is *de facto* policy. We have looked broadly at federal agency programs and distilled several objectives, design approaches, and transfer mechanisms which characterize federal activities in support of local EDP.[5] We refer to this melange of objectives, approaches, and mechanisms as "federal policy." Table 1 summarizes federal activities for local EDP.

Duality of Federal Objectives

Federal objectives for local government EDP have been a response to both local and federal needs.[6] First, federal efforts sought to fill gaps that existed in the local application market. Applications for police, fire, and social services were less available than applications for core organizational functions like accounting and budgeting because they had no analogue in the private sector. Consequently, federal assistance was used to develop and transfer such applications. Second, federal support attempted to raise the sophistication of computer use—from automation of routine operations to support of decision making. These efforts took the form of urban data banks and urban development models. Third, federal involvement in urban programs led to support of local computer applications which would provide the housing, employment, and other data needed by federal agencies to manage the programs.

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Table 1. Elements of Federal Policy Towards Local Government EDP

Federal Objectives
- Fill gaps in local application market
- Support urban decision making
- Generate data for federal program management
- Improve local capability to implement federal programs

Design Approaches
- Systems approach—develop comprehensive and integrated information systems, e.g., USAC
- Functional approach—develop a range of discrete applications for specific functional areas of local government, e.g., LEAA applications for local law enforcement
- Ad hoc approach—develop stand-alone, narrow-purpose software, e.g., fire service applications of Commerce and HUD

Transfer Mechanisms
- Research and demonstration—create prototypes suitable for transfer
- Reporting requirements in federal programs—incorporate automated reporting systems as a requirement for receipt of federal funds, e.g., UCR, FARE
- Subsidies for local development—provide federal subsidies for local agencies to develop their own applications within broad federal guidelines

Fourth, computing was used to support applications that might improve local capabilities to cope with critical problems, thereby potentially enhancing the successful implementation of federal programs. Computerized information and referral systems were part of the federal strategy for "social services integration;" automated wants/warrants for the "war on crime."

Thus, federal objectives represent both a strictly federal interest in nationwide statistics and an enlightened federal interest in problems of an increasingly urban society. While these objectives are compatible in theory, they often have been incompatible in practice.[7] Spending federal monies for strictly federal purposes such as gathering statistics about the society has always been considered appropriate even if it involved subsidies to local governments as inducements for them to participate. However, spending federal monies for essentially local EDP development has had little support, even if these expenditures had secondary information benefits for federal programs. Consequently, automation in support of statistics gathering (e.g., census, crime reporting) has been continuous and funded at an increasing level, whereas automation in support of extending local applications (e.g., databanks, models, management applications) has been ad hoc and characterized by periods of both feast and famine.[8]

Design Approaches for Computer Applications

Federal approaches to the design of computer applications software can be characterized as: systems, functional, and ad hoc. The *systems approach* is illustrated by the work of the Urban Information Systems Inter-Agency Committee (USAC).[9] This consortium of 10 federal agencies, under the leadership of the Department of Housing and Urban Development, sought "to develop multifaceted data bases from multiple local jurisdictions to serve intergovernmental data requirements, and, simultaneously, to facilitate integrated local planning and execution of functionally discrete federal programs."[10] USAC's primary means of achieving this end was to build "comprehensive" and "integrated" information systems in local governments as "building blocks" for intergovernmental systems.

The *functional approach* to applications software design involves the development of a range of discrete applications for local government operating agencies by their federal counterpart.[11] Perhaps the best examples of the functional approach are the geoprocessing applications for local planning agencies developed by the Census Bureau and the prosecution management applications for local criminal justice agencies developed by the Law Enforcement Assistance Administration (LEAA).

The *ad hoc approach,* with its temporary involvement of federal agencies, most frequently has produced stand-alone, narrow-purpose software designs. Examples include the community shelter planning applications of the Office of Civil Defense and the fire service applications of the Departments of Commerce and Housing and Urban Development.

Federal Mechanisms for Transfer of Applications

While software design represents one means by which federal objectives have been implemented, appropriate mechanisms to "push" or "pull" an application through the various links between R&D and local use have been equally important. Three primary mechanisms have been employed in the transfer of computer applications: research and demonstration; reporting requirements attached to various federal programs; and subsidies for local application development.[12]

Research and demonstration involves joint federal-local projects intended to create prototype applications suitable for transfer. The expectation is that the prototypes will demonstrate the potential benefits of advanced computer applications and thereby "pull" local government practice towards the prototypes without direct federal investment in aiding transfers. The experiments with databanks, urban models, and integrated information systems illustrate early attempts to build prototypes which could be widely transferred. More recent demonstrations have involved simpler applications such as uniform fire incident reporting systems, fire station locator, and manpower allocation models.

Reporting requirements in federal programs, as methods of application transfer, involve the incorporation of automated reporting systems as requirements for local governments receiving funds from federal programs. Local agencies are required to adopt the automated system if they wish to participate in a program, but the cost of implementing and operating the reporting system is an allowable local expenditure under the program. Examples include

welfare accounting and reporting systems, uniform crime reporting systems, and fare accounting and reporting systems.

Subsidies for local application development, incorporated in categorical, block and revenue-sharing grants, involve subsidies for local agencies to develop their own applications within broad federal guidelines. The only constraints governing development are the nature of the program and the need to demonstrate an association between the information system and the purposes of the grant.

Findings About the Diffusion of Applications Among Local Governments

Setting aside for the moment the federal policy context for application diffusion, we review our findings about application diffusion which are summarized in Table 2. The purpose for examining diffusion is to later determine the fit between federal policy and features associated with the diffusion of applications to local government.

Description of the Research

Our findings are an outgrowth of six empirical studies on computing in local governments.[13] These studies examine the influence of the following features on application diffusion:

- Innovation attributes and policy interventions
- Supply and demand in the local application market
- Cooperation in urban intergovernmental networks
- Environmental characteristics
- Executive support
- Staffing and organizational arrangements

Because of the complexity of each individual study, summary and illustrative data rather than the original study data are reported here in support of the findings. For the original data, readers are referred to the citations in the footnotes. The data on city and county EDP capabilities and characteristics used in these studies were gathered through a 1975 survey conducted by the Public Policy Research Organization (PPRO) of the University of California, Irvine.[14] This survey included all cities in the United States with a population of 50,000 or more and all U.S. counties with populations of 100,000 or more. Three questionnaires were distributed to each government: (1) a questionnaire soliciting the chief executive's views on EDP; (2) a questionnaire inventorying each government's data processing installations; and (3) a questionnaire inventorying each government's computer applications. Mayors, city managers, county executives, and county administrative officers received the chief executive questionnaire; data processing managers received the installation and applications questionnaires.

The chief executive questionnaire was designed to determine attitudes towards EDP and to identify political and administrative characteristics of the local governments. The installation and application questionnaires were designed to determine: organizational arrangements of EDP; standard operations and policies of the installation; the officials controlling major departmental decisions; the backgrounds of EDP technical management and staff; financing of EDP; hardware and software characteristics; and computer applications, including transfer data. Response rates for the three questionnaires were exceptionally good: 80 per cent for the chief executive questionnaire, 72 per cent for the installation questionnaire, and 71 per cent for the application questionnaire. Data from secondary sources, such as the *City and County Data Book,* were used to supplement the survey data.

Although the survey was conducted in 1975, the conclusions drawn from it are relevant today. Computer technology continues to evolve rapidly, but the problems of developing applications for the technology remain similar. Furthermore, the many smaller local governments now beginning EDP development can benefit from knowledge of the diffusion experience of other governments. Finally, while federal support for local EDP has slackened in recent years, few changes in federal activities for local EDP have occurred within the remaining programs.

Table 2. Features which Contribute to Computer Application Diffusion

Design Approaches

- *Design features of computer applications*
  - Organization-wide utility
  - Ease of evaluation
  - Serve both bureaucratic and client needs
- *System-building features*
  - Adoption of discrete applications rather than a single comprehensive system
  - Adoption of gateway applications which pave the way for other applications
  - Selection of applications which reinforce existing political structures

Transfer Mechanisms

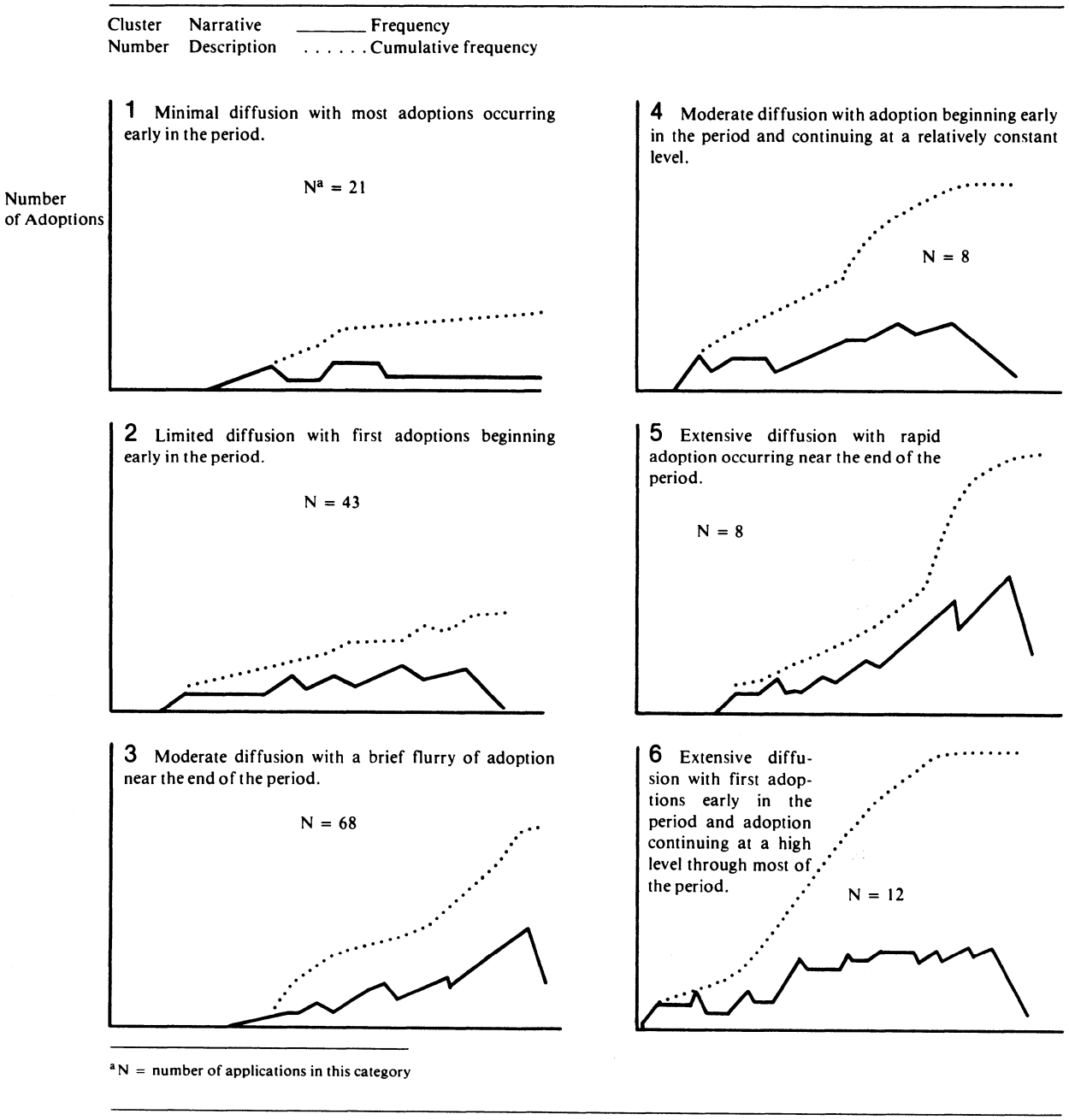
- *Market features*
  - Private market provides sufficient number of suppliers to facilitate diffusion
  - The local government market is not so greatly segmented that it creates aggregation problems for suppliers
- *Transfer features*
  - Slack resources (extra money, staff, computer capacity) in both the transferring and recipient governments facilitate transfer
  - A combination of vendors and in-house personnel provides an adequate supply of applications for small local governments
- *Federal support features*
  - Federal financial support for application increases their diffusion, but distorts local application priorities and might promote applications with little local utility

Summary of Findings

The diffusion patterns of computer applications vary considerably. With the overall pattern of diffusion defined by the extent and rate of diffusion and the time of introduction of an application, six patterns of diffusion were identified for the population of local government applications (Figure 1). Among the diffusion patterns are the standard S-curve cumulative frequency distributions (clusters 4, 6), several which suggest a flurry of adoption due to federal support (clusters 3, 5), and several representative of nondiffusion applications (clusters 1, 2).

The design of the application has a significant influence on its subsequent diffusion. Diffusion was enhanced for applications which represented a significant departure from current technologies. The positive association of this variable with *both* rate of adoption measures (Table 3) indicates that an application's departure from existing technologies has a moderate dampening effect on its adoption in the initial stages of diffusion but has a positive effect during the peak years. Diffusion also was enhanced for applications with organization-wide utility and performance that could be specified and evaluated (Table 3).

Figure 1. Computer Application Diffusion Patterns Among Local Governments



[a] N = number of applications in this category

These findings are illustrated by financial management applications which are likely candidates for adoption because: they are linked to operations within all local government subunits; their performance can be compared with non-automated procedures and explicit evaluative criteria; and they generally represent significant departures from manual methods of budgeting, forecasting, and accounting. In contrast, information and referral systems are much less likely to be adopted since they are linked to social services provided mainly outside the government, confined to use within a single government subunit, limited in criteria against which to monitor their performance, and not significantly different from manual clerical operations.

Interestingly, policy interventions do not appear to have significant impact on diffusion (Table 3). Only federal financial support is significantly related in this table, and then only to the rate of computer application adoption.

The supply and demand sides of the local government computer application market function quite effectively and do not appear to be major impediments to diffusion. The local availability of software suppliers (e.g., private firms, federal and state agencies) appears to have no influence on innovation diffusion. Local governments usually have access to a sufficient number of local suppliers. If the local supply of the computer software is inadequate, local governments then rely upon suppliers outside of their geographic area.

On the demand side, the diversity of needs among different local governments is believed to be a major barrier to creating profitable markets for software suppliers. However, the diversity of the local government market does not appear to be significantly different from that of private sector markets. Characteristics such as size and wealth, which segment the private sector market, also segment the local government market. Among all the characteristics we studied (Table 4), however, size (reflecting the volume of information processing) and wealth (reflecting the probable breadth of services) were the *only* characteristics which differentiated the diffusion of applications among local governments. Larger, wealthier governments tended to adopt more computer applications than smaller, poorer governments.

Unique features of the local government market were not significant predictors of application diffusion. Characteristics such as the percentage of intergovernmental revenue, whether the government was a city or county, and the region in which the government was located were poor predictors of variations in diffusion patterns. Thus, diversity in the local government market is related to factors similar to those in the private sector, but not to unique factors.

System-building is an incremental rather than a comprehensive process. Local government information systems might be constructed through comprehensive efforts, or might evolve incrementally. Comprehensive information

Table 3. Multiple Linear Regressions for Extent and Rate of Computer Application Adoption

	Extent of Adoption	Rate of Adoption	
Independent Variables	Cumulative percentage of adoptions for an application	Number of applications adopted per 10 most active years of adoption	Number of years for the application to diffuse to 3% of the population
Innovation Attributes			
Increasing complexity of the application	.00	.02	.10
Increasing organizational utility	.38***	.38***	− .06
Ease of communication about the application	− .06	− .06	.08
Departure from current technologies	.29***	.24***	.49***
Increasing ease of evaluation	.25**	.29**	.08
Cost of the application relative to other agency applications	.08	.11	− .22**
Policy Interventions			
Locus of development (local, commercial, or federal)	− .09	− .03	− .06
Amount of professional comunication about the application (journals, trade magazines, etc.)	.12	.13	.10
Availability of federal financial assistance	− .10	− .09	− .19*
Constant	− .03	− 8.03	8.58
R^2	.36	.33	.29
F	6.43***	6.11***	4.76***

*p < . 05
**p < .025
***p < . 01

Table 4. Relationships Between Adopter Characteristics and Demand for Computer Applications

Adopter Characteristic	Importance in Creating Demand for Computer Applications[a]
Median population (size)	Important (.81)
Median per capita expenditures (wealth)	Important (.52)
Median percentage intergovernmental revenues	Not Important (.16)
Region	Not Important (.19)
Governmental type (city or county)	Somewhat Important (.37)

[a]The coefficients in parentheses represent the weightings of the variables in a discriminant analysis for which the pattern of diffusion was the dependent variable. The coefficients can vary between plus or minus 1, therefore the higher the coefficient the more important the adopter characteristic.

systems, such as FAMIS (Financial Accounting and Management Information Systems)[14] and PROMIS (Prosecution Management Information System), are not likely to be widely adopted by local governments. However, independent applications which perform some functions of these comprehensive systems are likely to be widely adopted. A functionally-oriented group of independent applications frequently performs many of the same tasks as a single comprehensive system. While it is unclear whether functionally grouped applications are qualitatively equivalent to the comprehensive systems, it is clear that systems performing similar tasks eventually result from both approaches. Furthermore, the development of EDP is more likely to proceed incrementally than comprehensively because of difficulties in rapidly and simultaneously obtaining fiscal resources, in-house expertise, high level hardware capability, and user acceptance of sophisticated EDP applications.

Some applications are more critical than others in system-building because of their "gateway" capacity. The diffusion of some applications was considerably greater than what was expected due simply to their characteristics. This suggests that some applications serve in a gateway capacity, paving the way for other subsequent applications.[15] Because EDP is a continuous innovation, this idea is particularly applicable to some computer applications. They frequently share common computer equipment, professional support, and data organization. Therefore, it is reasonable that some applications provide the foundation for other subsequent applications. Some illustrative examples of gateway-follower applications are presented in Table 5. Several police and property assessment applications diffused much more rapidly and extensively than expected. We believe this rapid and extensive diffusion is attributable to the gateway capacity of basic police and assessment applications. The Census Bureau's Address Coding Guide (ACG) application appears to be similarly related to the diffusion and adoption of DIME, ADMATCH, GRIDS, CUE and other geoprocessing applications.

The experiences of local governments show that transfer is infrequently relied upon as a means of application acquisition and, when it is used, something frequently goes wrong.[16] Despite the widespread adoption of EDP by local governments, few inter-jurisdictional transfers have taken place. The commonly asserted benefits of transfers such as low developmental costs and time savings for implementation are seldom realizable. In fact, some of our results, displayed in Table 6, suggest that transfer occurs most readily

Table 5. Illustrative Gateway-Follower Applications[a]

Application Area	Gateway Application	Follower applications[b]
Property Assessment	Real property records	Calculation of real property value, assessing Regression for residential property appraisals Regression for nonresidential property appraisals
Police	Police service data (type of call, location, etc.)	Arrest records Wants/warrants file Uniform crime reporting Stolen vehicles file Alias name file
Planning and Zoning	ACG/DIME	ADMATCH, GRIDS, CUE Streets and highways inventory and location data Housing survey data Land use inventory
Finance	Payroll preparation/accounting	Position classification Position control Employee records

[a]Adapted from Appendix 2-2 in James L. Perry and Kenneth L. Kraemer, *Diffusion and Adoption of Computer Applications Software in Local Governments* (Irvine, CA: Public Policy Research Organization, University of California, Irvine, 1978) and from Kenneth L. Kraemer and Mitch Modeleski, "Geosites: An Empirical Study of Geoprocessing in U.S. Cities and Counties," in *GBF/DIME System: A Geographic Dimension for Decisionmaking* (Washington, D.C.: Bureau of the Census, 1976), pp. 14-25.

[b]Diffused more widely than predicted.

when resources are plentiful rather than when resources are scarce. For smaller local governments just beginning to automate, a combination of vendors and in-house personnel appears adequate for meeting their needs. Transfer can be an efficient means of application acquisition only for larger, experienced local governments in search of relatively unique, specialized applications. Even then, a considerable amount of slack resources must be available in both the transferring and recipient organizations for transfer to be a viable means for acquisition of an application.

Federal financial support is a significant facilitator of application diffusion (Table 7) *but, on balance, its contribution to local development might be marginal.* Federal agencies tend to support applications which are more difficult to diffuse because they primarily serve federal interests or represent management innovations (e.g., DIME, information and referral systems, uniform fire reporting systems) which have less interest locally than do operations-oriented applications. This is partly responsible for the low associations between federal assistance and the rate and extent of adoption reported in Table 3. However, federal assistance tends to be a much better predictor of overall patterns of diffusion (represented by the patterns in Figures 1) than it does of rate and extent of adoption. Discriminant analysis indicates that federal assistance importantly differentiates between minimal and extensive patterns of diffusion (Table 7).

This positive evaluation of federal assistance is counterbalanced by possible unintended consequences of federal assistance. Local officials who adopt applications motivated by federal financial support tend to overlook inadequacies of federally-supported applications for meeting local government needs. Yet, even in the absence of federal assistance, most applications attractive to local governments will diffuse widely and relatively quickly.

Moreover, federal assistance might distort local development priorities. LEAA assistance, for example, is related not only to higher rates of diffusion for non-police applications, but also to lower rates of diffusion for non-police applications. Functionally oriented federal assistance encourages automation in the supported department of the local government, but also shifts resources away from automation in other functional departments. Apparently federal assistance changes local development priorities because the local government's development capacity is limited at any point in time.

The adoption of computer applications is often a political activity. Several of our studies indicate that adoption of computer applications is a political activity rather than the apolitical process most frequently portrayed in the diffusion literature. Which computer applications are adopted is determined in large part by existing patterns of power, influence, and resource allocation in local governments. Those government functions which already have EDP innovations, which already have other innovations, and which tend to receive the larger share of local resources also tend to have a greater likelihood of getting computer applications adopted in their area. High level officials and department heads are key actors in the politics of application adoption, as each seeks to allocate EDP resources differentially in accordance with their perceptions of political

Table 6. Comparative Resources of Cities and Counties That Have Transferred Applications

Resources	Cities		Counties	
	Transfer Sites[a] N = 51	Non-Transfer Cities N = 351	Transfer Sites[a] N = 49	Non-Transfer Counties N = 261
Community Resources				
Population	219,762	156,501	385,679	371,007
Governmental Resources				
Average operating expenditures	$72,568,750	$51,201,521	$71,279,272	$66,223,494
Per capita expenditures	$306	$301	$222	$132
EDP Resources				
Average EDP expenditures	$891,031	$554,444	$1,345,933	$965,155
Average EDP expenditures as a % of total operating budget	1.4%	1.0%	1.8%	1.7%
Average total core capacity in bytes	596K	346K	598K	450K
Average total operational applications	44	31	39	32
Average total operational applications on-line	11	6	7	6
Average total operational applications with documentation	25	15	24	18

[a]This includes only places that have transferred-*in*. As might be expected, places that have transferred-*out* have somewhat higher values.

Table 7. Relationships Between Independent Variables And Patterns Of Adoption

	Importance of Influences on Overall Pattern of Diffusion (See Figure 1)[a]
Innovation Attributes	
Increasing complexity of the applications	Not important (.19 & .14)
Increasing organizational utility	Important (−.10 & .58)
Ease of communication about the application	Not important (−.14 & −.31)
Departure from existing techniques	Important (−.55 & .45)
Increasing ease of evaluation	Important (−.11 & .58)
Cost of the application relative to other agency applications	Not important (−.22 & .18)
Policy Interventions	
Locus of development (local, commercial or federal)	Not important (.19 & .00)
Amount of professional communication about the application (journals, trade magazines, etc.)	Not important (.16 & .00)
Availability of federal financial assistance	Important (.77 & .51)

[a]The coefficients in parentheses represent the weightings of the variables in two discriminate functions. The importance of the variable is based on whether the coefficient was significant in one of the two functions.

advantage or "need." The greater the level of their support for EDP, the more likely their efforts to influence EDP resource allocation.

Assessment Of Federal Policy In Light Of The Diffusion Findings

Only one design approach and a single transfer mechanism enjoy significant success when judged against the diffusion criterion. The functional approach to software design, with its reliance on each federal agency developing a range of applications for its local government counterpart, has been much more successful than either the comprehensive or the ad hoc design efforts. Similarly, federal subsidy has achieved a much greater diffusion effect than research and demonstration or programmatic requirements.

The reasons for the different levels of effectiveness of the federal design and transfer mechanisms are apparent from the findings of our studies. The functional design approach is more likely to take account of local needs because of the strong ties between the federal agency and its local counterpart. Similarly, the range of applications and long-term federal agency commitment generally associated with the functional approach enhance incremental system-building processes at the local level and produce "leader" (gateway) as well as "follower" applications. Both the comprehensive and *ad hoc* design approaches have shortcomings with respect to these processes. Comprehensive designs are inconsistent with incremental system-building processes and can be expected to tax local data processing expertise. *Ad hoc* design efforts, while more closely related to the functional approach than the comprehensive approach, fail to take account of the gateway requirements of some applications.

A similar assessment can be made of the three transfer mechanisms. Research and demonstration, with its assumption that advanced prototypes will diffuse widely once built, is inadequate for two reasons. Very little transfer of applications occurs in local governments; and, common assertions about the ease, speed, cost savings and other benefits of transfer seldom fit the reality of transfer experiences in local governments.[17] Reporting requirements tend to induce rapid adoption initially, but are unsuccessful in the long run. Since federal reporting requirements seldom are compatible with local information requirements, the automated reporting systems are incompatible with local goals in the long run. Consequently, local governments discontinue the systems when federal program support ends.[18] This is both a failure to recognize incompatibilities between federal and local information needs and a failure to recognize where those needs might be compatible. Subsidy, though its has accomplished diffusion, also is a problematic transfer mechanism because it tends to be cost ineffective and leads to unpredictable consequences. It is cost effective when the local governments use federal funds to adopt systems they would have adopted anyway without the federal support. Federal subsidy sometimes merely displaces rather than stimulates local investment and therefore does not act as a necessary condition for the adoption of computer applications.[19] Subsidy also tends to be a relatively unpredictable transfer mechanism since there are few constraints on what kinds

Local officials who adopt applications motivated by federal financial support tend to overlook inadequacies of federally-supported applications for meeting local government needs. . . . Moreover, federal assistance might distort local development priorities.

of computer applications the local agencies may develop. Subsidy seems well suited for building local computing capability and for reinforcing local automation goals, but these may have little to do with federal goals.

. . . adoption of computer applications is a political activity. . . . Which computer applications are adopted is determined in large part by existing patterns of power, influence, and resource allocation in local governments.

Conclusion

Our analysis suggests that present federal design approaches and transfer mechanisms for the diffusion of applications are not particularly effective. One reason is the failure of federal agencies to recognize adequately the differences in federal and local information needs and the nature of automated systems required to meet these needs. This occurs because there is no unified policy for local information systems support in the federal government. There are only the policies of individual agencies which derive mainly from the specific role of information or automated systems in individual agency programs. For example, automated information and referral (I&R) systems became part of the HEW strategy for "integration of social services" when someone perceived that information might be used to integrate social service agencies. This strategy was adopted sequentially by federal health, welfare, and aging offices and disseminated through funding support for I&R systems to their local government counterparts. Consequently, some local governments have three different I&R systems operating simultaneously; others have sequentially built and discontinued I&R systems first for health, then for welfare, and most recently for the aging; only a few have managed to retain and adapt the same basic I&R system for all three functions.

When federal agencies attempt to deal with purely local needs, such as in USAC, there is a tendency to seek a quick, comprehensive technological fix. Theoretically, the comprehensive approach is fine because it recognizes local government as a system. However, it fails to recognize that local governments are not capable of assimilating comprehensive designs and need incremental designs which lead to a comprehensive framework. The development of such a framework, which would be of actual substantive service to local governments, is incompatible with institutional and professional aggrandizement in the federal government. Real assistance to local governments in the area of computing requires substantial policy coordination and cooperation among federal agencies. Yet, there are few payoffs for interagency cooperation. Joint activities decrease the visibility of each agency, increase the cost of participation over going it alone, bring current agency policies under potentially negative scrutiny, and may require compromise of agency priorities. Consequently, few efforts aimed at federal interagency cooperation are undertaken, and those which are launched (such as USAC) rarely succeed.

Another reason why federal design approaches and transfer mechanisms are not particularly effective is the tendency of federal agencies to treat the various design approaches and transfer mechanisms as mutually exclusive. As a result, federal officials fail to consider policy options that mix the design approaches and the transfer mechanisms. Two options which merit consideration are consistent with our research. First, where federal objectives for the development of a new application differ from local objectives, a sequential program of federal support might be the most effective strategy for intervention. The initial stage would provide general subsidies for the development of local capabilities in areas related to the targeted application. The follow-on stage would then be earmarked for programmatic requirements to encourage the adoption of federally-targeted applications.

. . . there is no unified policy for local information systems support in the federal government. There are only the policies of individual agencies which derive mainly from the specific role of information or automated systems in individual agency programs.

Second, but related to the first policy, it is important that federal strategies recognize the incremental pattern of automation development in local governments. Generally, locally developed systems are built in increments which evolve, through redevelopment, towards more integrated, comprehensive and sophisticated applications. Consequently, an effective federal strategy for intervention might be to mold incrementally the direction of local development through the provision of sequenced sets of applications each of which builds upon previously established capacities. Of course, this requires continuous and sustained, though not necessarily large, federal support for application diffusion.

The political nature of applications adoption has implications for federal and local officials. From the federal standpoint it suggests that "general" financial support for local government computing might increase capacity, but that capacity will tend to be used primarily for current local priorities. It also suggests that the promulgation of particular computer applications by federal agencies requires that financial support be "earmarked" for those applications. However, unless the application clearly meets locally perceived needs and priorities, some additional carrot or stick incentives might be required to get local agencies to adopt federal perceptions of need or priority. One such carrot is the combination of "general" and "earmarked" support mentioned above.

From the local standpoint, it is important to recognize that substantial and continuous infusion of federal financial support can change the existing pattern of applications development in the government. Federal financial support clearly supplements rather than displaces local investment; but the heavy promotion of new development in one area tends to slow down or to retard development in other

areas. This occurs because local government computing capacity is fixed at any point in time, and can be changed only in large increments over a considerable time period.

. . . there are few payoffs for interagency cooperation. Joint activities decrease the visibility of each agency, increase the cost of participation over going it alone, bring current agency policies under potentially negative scrutiny, and may require compromise of agency priorities.

Most local governments assume that federal support is transitory and therefore shift development priorities temporarily rather than increase capacity. When financial support for an area (e.g., law enforcement) continues at a high rate, the federally-supported development tends to displace other planned development. Over time, therefore, it changes the pattern of local applications.

Finally, we are uncertain about the extent to which our conclusions about federal policy and computer application diffusion might also apply to other public technologies. However, the findings of other recent studies in local governments are sufficiently similar to suggest that our results might be generalizable to other public technologies, particularly urban management technologies.[20] Our observations about the local adoption of computing applications have a familiarity when measured against previous "federal pushes" for innovations in local personnel, budgeting, planning, and systems analysis.[21]

Notes

1. See, for example, Federal Council on Science and Technology, *Directory of Federal Technology Transfer* (Washington, D.C.: U.S. Government Printing Office, 1975).
2. See, for example, The Urban Institute, *The Struggle to Bring Technology to Cities* (Washington, D.C.: The Urban Institute, 1971) and J. David Roessner, "Federal Policy and the Application of Technology to State and Local Government Problems," *Policy Analysis*, (forthcoming). An excellent overview of the major federal programs, and their rationale, is contained in Robert Crawford, "The Application of Science and Technology in Local Governments in the United States," *Studies in Comparative Local Government*, Vol. 7, No. 2 (1973), pp. 1-19.
3. Federal policy towards local government EDP rarely is directed at computer adoption per se, but rather at the development and transfer of computer applications. An important exception has been the policy of the Law Enforcement Assistance Administration which provides funding support for the adoption of computers by local law enforcement agencies. An overview of federal policy circa 1970 is contained in Ruth M. Davis, "Federal Interest in Computer Utilization by State and Local Government," *The Bureaucrat*, Vol. 1, No. 1 (Winter 1972), pp. 349-356. See also the Fall 1978 symposium on information systems in *The Bureaucrat*.
4. Federal investment in state and local EDP is about $250 million annually, and local governments themselves spend about $1 billion annually. Since the largest investment is made by local governments, local EDP is strongly shaped by their objectives. Nevertheless, federal assistance has had substantial leverage effect, stimulating experimentation with new approaches, development of new applications, and transfer of packaged applications among local governments.
5. We have used the following, among other, sources in reviewing federal agency programs for local EDP support: the federal budget, the federal agency data submitted in response to OMB Bulletin 72-1, the report of the President's Commission on Federal Statistics, papers by individual federal officials, and newsletters and bulletins such as the *Federal Statistical Reporter*. The individual sources are too many to enumerate here.
6. This duality of objectives is illustrated by the following rationale for the USAC Program:

   > For one, the Federal Government finds itself pulled more and more into local problems with such programs as Model Cities, to cite one example . . . Moreover, the Federal Government has depended upon municipal government for much of the information which it used in attempting to provide national services. Unless the information fed from the local level can be improved, many of the services provided by the Federal Government will be inefficient at best, and quite often totally useless.
   >
   > (*Government Data Systems*)

   USAC stands for Urban Information Systems Inter-Agency Committee. The primary goal of the USAC Program was the creation of prototype integrated municipal information systems in six municipalities. Overall, $26 million was spent on the USAC Program over the five-year span of its research and development. Of this, the federal agencies contributed $20 million, and the six municipalities the remainder. See: "USAC: Federal Funding for Municipal Information Systems," *Government Data Systems*, Vol. 1 (July/August 1971), pp. 6-24; and "City Hall's Approaching Revolution in Service Delivery," *Nation's Cities*, Vol. 10, No. 1 (January 1972), pp. 11-46.
7. Rogers, et al., for example, cite the tension between federal and local levels over the Census Bureau's GBF/DIME application. See Everett M. Rogers, J.D. Eveland, the Constance Klepper, *The Innovation Process in Public Organizations: Some Elements of a Preliminary Model* (Ann Arbor, MI: University of Michigan, Department of Journalism, March 1977).
8. See, for example, Kenneth L. Kraemer and John Leslie King, "Laissez Innover: A Critique of Federal Involvement in Development of Urban Information Systems," *The Bureaucrat* (Fall 1978).
9. See footnote 6; also, Kenneth L. Kraemer, "USAC: An Evolving Intergovernmental Mechanism for Urban Information Systems Development," *Public Administration Review*, Vol. 31, No. 5 (September/October 1971), pp. 543-551. A recent critique of the USAC experience is provided in Kenneth L. Kraemer and John Leslie King, "Requiem for USAC," *Policy Analysis* (Summer 1979).
10. Kraemer, *op. cit.*, p. 544.
11. Anthony Downs, "A Realistic Look at the Final Payoffs of Urban Data Systems," *Public Administration Review*, Vol. 27, No. 3 (1967), pp. 204-210.
12. These are discussed in Davis, *op. cit.*, Office of Management and Budget, "Bulletin 72-1," and Kraemer and King, "Laissez Innover . . ."
13. This research has been supported by grants from the Division of Policy Research and Analysis of the National Science

Foundation (PRA 76-15549) and the RANN Division of the National Science Foundation (I.E. 41202500). James L. Perry and Kenneth L. Kraemer, *Diffusion and Adoption of Computer Applications Software in Local Governments*, Final Report submitted to the Division of Policy Research and Analysis, National Science Foundation (Irvine, CA: Public Policy Research Organization, 1978); and Perry and Kraemer, *Technological Innovation in American Local Government: The Case of Computing* (New York: Pergamon, forthcoming). Four innovation processes were examined in the research: adoption, adoptability, transfer, and diffusion. *Adoption* refers to *the decision surrounding whether or not* a particular computer application will be adopted by local governments. *Adoptability* refers to *probability that an application* will be adopted by local governments. *Transfer* refers to the process of moving a computer application developed in one local government (or federal, state or private agency) to another local government. *Diffusion* refers to the overall spread of computer applications among local governments.

14. The survey was supported by the National Science Foundation, Research Applied to National Needs Division (I.E. 41202500).
15. Nan Lin and Gerald Zaltman, "Dimensions of Innovations," in *Processes and Phenomena of Social Change*, ed. Gerald Zaltman (New York: John Wiley and Sons, 1973), pp. 93-116 at 109.
16. Kenneth L. Kraemer, "Local Government, Information Systems, and Technology Transfer," *Public Administration Review*, Vol. 36, No. 4 (July/August 1977).
17. The shortcomings and utility of federal demonstration projects do not appear to be limited to computing. See Walter S. Baer, Leland L. Johnson and Edward W. Merrow, *An Analysis of Federally Funded Demonstration Projects: Final Report* (Santa Monica, CA: Rand, 1976).
18. Rogers, et al., *op. cit.*
19. George F. Break, *Intergovernmental Fiscal Relations in the United States* (Washington, D.C.: Brookings, 1967).
20. See, for example, the recent studies of Richard D. Bingham, *Technological Innovation in Local Government* (Lexington, MA: Lexington Books, 1976); Irwin Feller and Donald Menzel, *Diffusion of Innovations in Municipal Governments* (University Park, PA: Institute for Research on Human Resources, 1976); and Robert K. Yin, Karen A. Heald, Mary E. Vogel, Patricia D. Fleischauer and Bruce C. Bladek, *Tinkering with the System: Technological Innovations in State and Local Services* (Lexington, MA: Lexington Books, 1977).
21. Ida A. Hoos, *Systems Analysis in Public Policy* (Berkeley, CA: University of California Press, 1972); and Allen Schick, *Budget Innovation in the States* (Washington, DC: Brookings Institute, 1971).