A Requiem for USAC

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The USAC program was the largest federal-local joint project yet undertaken to develop a major prototype technology for use in urban management—the integrated municipal information system. The authors evaluate the USAC program's philosophy, impacts, successes and failures, and policy implications, with the intent of providing a comprehensive overview of the meaning and lessons of USAC. The USAC program was largely a failure in accomplishing its stated objectives, but as an experiment it provides valuable insight into the difficulties of organizing and carrying out major technological development and diffusion efforts in the public sector.

The USAC program, an innovative and controversial federally-supported experiment in development of urban information systems, came to an official end on 7 January 1977 (*USAC* stands, somewhat cryptically, for *U*rban Information *S*ystems Inter-*A*gency *C*ommittee). Thus concluded an important federal-local cooperative program that achieved national and international recognition among professionals and academics in the fields of urban management and information systems. During its seven-year life USAC was characterized by an expenditure of nearly $26 million in federal and local government money; an ambitious program involving research and development (R&D), implementation, and evaluation; a unique,

We wish to acknowledge the helpful comments and assistance of James McManama, Gerald Fox, Patrick Hamilton, Robert Metzger, Joseph Motto, Steve Savas, and two anonymous reviewers. This research is supported in part by a grant from the National Science Foundation to the Public Policy Research Organization, entitled "Evaluation of Information Technology in Local Governments," and called URBIS (Urban Information Systems). The opinions expressed herein are those of the authors and should not be attributed to the reviewers, the URBIS group, or the National Science Foundation. Our names are listed randomly to denote equal contribution.

0098-2067/79/030313+37$00.50

formally established working arrangement of city governments, information system consultants, and universities; and an inventive overall program structure built around a consortium of ten federal agencies interested in development of urban information systems.[1] The passing of USAC signals the end of a significant era in the evolution of urban information systems, and, moreover, the end of a whole format for federal assistance to local governments.

This paper provides a critical assessment of the USAC experiment. It includes (1) an overview of the USAC program and its central concept of the "integrated municipal information system," (2) an account of the progress of USAC site cities in urban information systems as compared with non-USAC cities, (3) an assessment of the validity of USAC concepts and the lessons learned from the USAC experience, (4) a discussion of the "systems consciousness" that formed the foundation of the entire USAC program, and that in the end accounted for many of its problems, and (5) a set of conclusions about the policy implications of USAC for other federal-local technology efforts.

OVERVIEW OF USAC

The USAC program was built around a program philosophy with specific strategies and goals, an institutional structure for execution of the program, and processes and projects for research and development.[2]

USAC Philosophy, Innovation Strategy, and Goals

USAC's underlying philosophy perceived local governments as major links in the overall governmental system. From the federal

1. The federal agencies expended $20 million and the cities the other $6 million of the total expenditure. Of the federal agencies, HUD spent the most ($11.2 million) and HEW second most ($4.8 million). See USAC Support Panel of the National Research Council, *Local Government Information Systems: A Study of USAC and the Future Application of Computer Technology* (Washington, D.C.: National Academy of Science, 1976), p. 9.

2. For background information on USAC see Kenneth L. Kraemer, "The Evolution of Information Systems for Public Administration," *Public Administration Review* 29 (July–August 1969): 389–402; idem, "USAC: An Evolving Intergovernmental Mechanism for Urban Information Systems Development," *Public Administration Review* 31 (September–October 1971): 543–51; idem, "Information in Urban Systems," *International Review of Administrative Science* 40 (1974):3–15; and Barry Wellar, *The Urban Information Systems Inter-Agency Committee (USAC) Experience: Some Lessons Learned* (Ottawa, Canada: Ministry of State for Urban Affairs, 1973).

perspective, local governments serve as general instruments of government through their roles as implementation vehicles for federal programs, as service sectors of increasing importance in the national economy, as data sources for federal program planning and evaluation, as delivery vehicles for urban services, and as coordinating mechanisms for comprehensive local planning. The USAC philosophy held that the importance of local governments warranted federal government assistance in improving local government planning, management, and operations.[3] The USAC architects further believed that the most promising tool for achieving this improvement was increased use of computers and automated information systems: information systems could automate routine information processing tasks, thereby improving productivity in the information-dependent field of local government management; they could be used in analysis and redesign of municipal goals and activities; they could integrate data and data processing, creating a dynamic data base for use in planning, management, and integration of local operations. Ultimately, the designers of USAC felt that the use of computers could result in development of new sociotechnical systems offering increased local government efficiency and improved service delivery.

As with other federally supported programs for demonstration of new technological ideas, USAC's innovation strategy came into existence because urban information systems experts believed that decentralized, private market mechanisms would not provide sufficient incentive for development of the technology in the interests of

3. The intellectual antecedents for both the USAC Committee and the IMIS research and development program (to be discussed) were in research conducted at the University of Southern California, the University of Connecticut, and the IBM-New Haven Project. See William H. Mitchell, "An Approach to the Use of Digital Computer in Municipal Government" (Ph.D. diss., University of Southern California, 1968); Municipal Systems Research Project, *The Municipal Information and Decision System Project* (Los Angeles: University of Southern California, School of Public Administration, 1968), *Phase One, Final Report,* and *Overview*; Municipal Information Technology Program, *A Regional Municipal Information Handling Service for the Capital Region,* 2 vols. (Hartford, Conn.: University of Connecticut, Institute of Public Service, and the Travelers Research Center, 1967); IBM–City of New Haven Joint Information System Study Staff, *An Urban Management Information System,* 32 vols. (New Haven, Conn., 1969). An excellent review of these and other related projects is Barry S. Wellar, "Evaluation of Major Research and Development Efforts, in *The Wichita Falls Consortium Phase I Report,* NTIS PB 206 789–18 (Springfield, Va.: National Technical Information Service, 1970), vol. 4, *Project Related Research.*

cities or the intergovernmental system.[4] Therefore USAC could not rely upon passive development and diffusion provided by the existing private market mechanisms, and undertook an active promotional role.

Active promotion of innovation development and diffusion requires adoption of one or both of the incentive systems relied on in passive development and diffusion under successful market conditions.[5] Passive development and diffusion of innovation typically depends on supply-push incentives, in which innovations are developed in the self-interest of developers and "marketed" to prospective users based on their purported benefits; or on demand-pull incentives, in which a technical fix is literally pulled into existence and adopted on the basis of existing demand. Counterpart strategies are used in active development and diffusion projects. The supply-push strategy typically utilizes publicly funded demonstration projects and financial incentives to entice users into adopting demonstrated innovations. The demand-pull strategy essentially relies on creation of an "artificial" demand somewhere in the future that requires users to respond by developing and adopting innovations that will help them meet the demand. The premier examples of this are found in the automobile manufacturing industry, where the federal clean air and fuel economy mandatory standards act, in effect, as "pulleys" that allow public policy to "pull" technological development and diffusion toward desired goals.

USAC relied principally on the supply-push strategy for development and diffusion, based on the assumption that there was an existing demand for the products of USAC and that the USAC products would be transferable at a sufficiently low cost to entice many local

4. Three factors are usually associated with this kind of market failure: private profits are inadequate even though social benefits might be great; uncertainties about the technology make the investment too risky, despite potential private profits; and nontechnological obstacles, such as regulation, political opposition, or public resistance, make success too uncertain. See Walter S. Baer, Leland L. Johnson, and Edward W. Merrow, "Government-Sponsored Demonstrations of New Technologies." *Science* 196 (27 May 1977):950.

5. See Edwin Mansfield, *The Economics of Technological Change* (New York: Norton, 1968); R. R. Nelson, M. J. Peck, and E. D. Kalachek, *Technology, Economic Growth, and Public Policy* (Washington, D.C.: Brookings Institution, 1967); R. R. Nelson and S. G. Winter, "Growth Theory from an Evolutionary Perspective," *American Economic Review* 65 (1975): 338–44.

governments to acquire them to meet their information needs. The federal government would underwrite most of the cost of prototype development and would provide financial assistance for transfer of the systems. A long-range demand-pull aspect to the USAC strategy, however, called for development of federal and local information standards that would in time practically require governments to adopt USAC components in order to be in compliance with the standards.

The goals of USAC, then, were to provide funds as an incentive for research and development in application of information systems to urban management, to ensure the technical quality and practical utility of the resultant information systems applications, to assist in transferring the developed applications to non-USAC cities, to coordinate and provide a focus for the many non-USAC federal programs in the area of urban information systems, and eventually to build toward an intergovernmental information network.

Institutional Structure of USAC

To accomplish USAC's goals, the initiators of USAC developed two institutional structures: one programmatic and at the federal level; the other project-specific for each selected experimental site. The programmatic structure was developed as a contractual consortium called the USAC Committee, made up of ten federal agencies, all of which had programs and/or interests in development and use of urban information systems.[6] All ten agencies contributed money and personnel time to the program. For ease of management a single agency, the U.S. Department of Housing and Urban Development (HUD), was chosen as the lead agency for the program. In theory, the committee was to provide policy guidance for the program, while the program management group in HUD (consisting of

6. The federal agencies in USAC were HUD, HEW, the Department of the Army's Office of Civil Defense, the Department of Commerce, the Department of Justice, the Department of Labor, the Department of Transportation, the Office of Economic Opportunity, the Office of Management and Budget, and the National Science Foundation. For more detail on the USAC Committee and USAC plans, see Kramer, "USAC: An Evolving Intergovernmental Mechanism"; and William H. Mitchell, "After USAC, What?" in *Urban and Regional Information Systems Association Conference Proceedings* (Kent, Ohio: Kent State University, Center for Urban Regionalism, 1969), pp. 415–22.

program consultants, federal bureaucrats, and representatives from the major urban public interest groups) was to execute this policy and manage the program. Thus USAC had three innovative programmatic characteristics: it used a temporary matrix organizational structure, borrowed from the defense and aerospace industry; it used a set of contracts as a mechanism for creating and maintaining its program structure; and it used the unique tool of a formal but temporary interagency organization to provide the statutory basis for "pooling" of money from the nine agencies.

At the local level each city chosen as a site acted as the lead agency for a smaller local consortium made up of three parties: the city government itself, which served as the site for the R&D; a computer software development firm, which provided the technical and knowledge resources for the R&D; and a university, which served to monitor and evaluate the progress of the local activity. These groups also were organized by means of contracts with each other and with HUD.

In addition to the programmatic and local organizational structures, temporary site visit teams were assembled from the member agencies of the USAC Committee and the program management group in HUD to visit and evaluate the local sites on a quarterly basis. An interconsortium panel made up of representatives from all the participants also was convened on a semiannual basis to exchange information.

The USAC Program for Research and Development

USAC borrowed its model of the R&D process from the defense and aerospace industry. Essentially that model posited the USAC information systems objectives as products moving through a staged process from product specification, to prototype development, to transfer demonstration, to widespread diffusion. Municipal information systems were to be the first of several products developed by USAC through this process. Information systems for other local jurisdictions and for interfacing these jurisdictions with state and federal agencies were to follow. Municipalities were chosen as the first object for R&D because they were viewed as the basic building blocks for intergovernmental systems.

Integrated Municipal Information Systems—USAC's first program was to conduct R&D into a concept called integrated munici-

pal information systems (IMIS). Seven key concepts underlaid the IMIS program.[7]

- *Total systems and subsystems,* which postulated building of a total municipal information system based on four functional subsystems, representing public safety, public finance, physical and economic development, and human resources development.
- *Integrated data processing,* which suggested that all data in an IMIS be conceived of logically as a single data base, constructed both "vertically" to encompass each municipal function, and "horizontally" around the principal objects of people, property, money and personnel that cut across municipal functions. Integration further suggested that data processes be interrelated logically and physically such that one process automatically trigger another when appropriate.
- *Operations-based automation,* which held that most data required for municipal planning and management existed in the practical, operational data files of municipal agencies, and that the sensible way to provide planning and management data was as a by-product of operational automation. A single source could be identified for generation of each data element, thus optimizing data generation.[8]
- *The prototype development process,* consisting of systems analysis, systems conceptualization, systems design, systems development, systems implementation, and systems evaluation. This process

7. These seven concepts and others were set forth in a request for proposals issued by USAC. They were subsequently elaborated further in a book and in a collection of papers dealing with USAC concerns. See U.S., Department of Housing and Urban Development, "Municipal Information Systems," RFP H–2–70 (Washington, D.C., 1970); and Kenneth L. Kraemer et al., *Integrated Municipal Information Systems* (New York: Praeger Publishers, 1974).

8. The USAC Committee did not expect that the routine operating activities of municipal departments would provide *all* the data required for planning and management. The committee recognized that some important data—for example, data about the larger urban region—could not be provided by automation of routine operations but had to be generated independently. Some writers argued that the routine operating activities would produce little or none of the information required for planning and management. See David Leninger, "Beyond USAC: Atlas Shrugged," *Urban and Regional Information Systems Association Conference Proceedings,* 1971, pp. 191–200; and George C. Hemmens, "Implementing the Integrated Municipal Informations Concept: The Charlotte, North Carolina Case," mimeographed (Chapel Hill: University of North Carolina, Department of City and Regional Planning, 1975).

would proceed across the board on all subsystems up through the systems development phase, with incremental implementation following.

- *Complete documentation,* intended to provide data for research, to expedite the jump from analysis to implementation, and also to facilitate transfer of the prototypes.
- *Systems and subsystems transfer to other cities,* intended to be encouraged by successful demonstration of the superiority of integrated systems over previous independent systems. This required that the prototypes be designed and implemented to facilitate transfer.
- *The consortium approach,* which, as mentioned above, made the city the prime contractor, with the systems development firm and the university as subcontractors to the city. The city would control R&D and assign the project director; the systems firm would provide technical expertise and training; and the university would provide technical advice and evaluation.

From the standpoint of research, it was expected that the projects would accomplish several tasks. They would define, for the first time, the complete data content and data processing environment of a municipal government, as well as the full potential scope and character of feasible automation in municipal government in keeping with the operational characteristics of "integrated" data processing. They also would develop solutions to problems in building systems, including problems of data privacy and data access, and would assess the impacts, costs and benefits of the IMIS. From the standpoint of development, it was expected that the projects would engineer the parts of the IMIS and implement them both as subsystems in an operational setting, and as prototypes for transfer to other cities. Thus the projects were R&D, not simply research and not simply development.

These concepts were embodied in a request for proposals (RFD) made available in 1970 to all interested cities having populations between 50,000 and 500,000.[9] Out of approximately 270 eligible cities, 79 submitted proposals. Awards were made in 1970 for total system projects to Charlotte, North Carolina, and Wichita Falls, Texas, and for subsystems to Dayton, Ohio (public finance), Long Beach, California (public safety), Reading, Pennsylvania (physical

9. See request for proposals, "Municipal Information Systems."

and economic development), and St. Paul, Minnesota (human resources development). The St. Paul project was discontinued early in the program due to problems discussed later in this paper.

A Summary of USAC Experiences

Nobody who initiated the USAC program or who bid on the USAC projects knew whether it was possible to do what was envisaged in the RFP. But both the federal initiators and the local contractors (cities, systems firms, and universities) hoped to come sufficiently close to satisfying the objectives to make the program worth the investment. While the initial days of the project were filled with enthusiasm, the first of the many problems developed soon after the projects were awarded. Federal contract negotiations delayed the official start time, after which it took nearly nine months to recruit staff, to prepare space for the project, and to work out the details of relationships within each local consortium. Systems analysis, the first phase of the projects, took considerably more effort, money, and time than anticipated. The late start-up and the overruns during systems analysis put the project a year behind schedule, with 25 percent of total project funds already spent.

It soon became apparent to everyone involved that the R&D tasks were more complex than anticipated. The concepts embodied in the RFP were difficult to implement because they were new and no one was sure what they meant in practice. There were false starts and restarts and frequent changes of personnel. It also became apparent that some systems firms did not have the technical skills for the task and that key city staff members in the various functional departments could not be made available to work on the projects as needed.

Word about the projects spread and city staffs became deluged with inquiries and requests to visit the project. These visits, in addition to the regular visits by federal officials and the interconsortium panel meetings, eventually became a large drain on project resources, and visits were curtailed in order for project work to progress. As the projects moved closer towards implementation of systems and applications, it was obvious that available time and money would not support full design, development, and implementation of everything that had been conceptualized. The choice was between federal and local goals, between development priorities and research priorities. The cities naturally preferred local goals and de-

velopment priorities, and, since they were the key to further implementation, their priorities won out. Thus the scope of development was greatly reduced.

These reductions resulted in disappointment with and criticism of the USAC program both inside and outside the USAC family. To stem the tide of criticism over federal project management, USAC officials rigidly insisted upon adherence to the letter of the contracts and instituted a formal request procedure for continuation funding. HUD, as the principal federal agency, became concerned that the cities would change from their original plans, so it required the cities to submit new proposals indicating exactly what was planned. Because the contracts were awarded to the cities on a year-to-year basis, and refunding was conditional on formally meeting HUD's requests and directives, the cities did not know for certain that they would receive the rest of the project money. The response of the local contractors to what had developed into a set of unreasonable expectations was to try anyway in the hope of coming sufficiently close to the original objectives that the government wouldn't cancel the contract, or better yet, would redefine the tasks to make them more reasonable.

A great deal of the time of local project staff people was consumed in writing and rewriting proposals to HUD, and a substantial portion of project finances were spent in this unproductive activity. The project staffs became increasingly demoralized, and HUD grew weary of the burden of USAC. Eventually, the goal of all remaining parties to the USAC program became the same—to meet their formal obligations and officially to end the projects.

Near the end of the IMIS projects in mid-1975, it was unclear whether the federal government should embark upon a program to test the transfer ability of the IMIS prototypes. The USAC Committee had been dormant for two years and the individual federal agencies belonging to USAC had withdrawn all support, leaving HUD with the added burden of deciding whether a program to test the transferability of the IMIS prototypes should be undertaken.

To assist in this decision, HUD commissioned an assessment of the IMIS projects by a special panel of experts in computer science, government, and information systems from the National Academy of Engineering (NAE). The NAE panel issued its report in mid-1976, concluding that USAC had had a significant impact on the development of information systems, but not the anticipated impact.

According to the panel, USAC had developed new knowledge about how to develop information systems, demonstrated the importance of involving elected and appointed officials in the development process, and pioneered in applying computer technology to a wide variety of municipal operations. The panel noted, however, that virtually no total systems had been transferred from the USAC cities to other local governments, and that the USAC program had had little impact on encouraging intergovernmental cooperation in the exchange of data.[10]

Following this report, HUD officials decided to end the USAC program formally and completely, and on 7 January 1977 issued a "close-out" memorandum. USAC was officially over.

STATUS OF USAC CITIES

While the USAC program is over, much interest in it remains. Yet a satisfactory postmortem has been wanting. We here present the status of the USAC cities at the end of 1975, setting the scene for our analysis of the lessons to be learned from USAC.

To be considered minimally successful, the USAC program should have improved the state of applications development, the state of computing capability, and the state of the computing environments in the USAC cities beyond what they would have been without the program. We use a simple framework to assess whether the USAC cities achieved such successes. The framework here longitudinally compares the USAC cities with the seventy-three cities that responded to the USAC request for proposals but that did not receive awards (referred to in the tables as "RFP cities"), and compares both USAC and RFP cities with the 1975 status of similarly sized cities not involved in USAC at all (table 1). The data for these analyses are from a 1970 HUD survey of the seventy-nine cities that responded to the RFP, the 1975 survey made by the Urban Information Systems (URBIS) project, and our own follow-up interviews.[11]

10. USAC Support Panel, *Local Government Information Systems,* p. 2.

11. URBIS is a four-year research project, studying the uses and impacts of computers in local government, conducted by the Public Policy Research Organization at the University of California, Irvine. This and other surveys are described in O. E. Dial et al., *Municipal Information Systems: State of the Art 1970* (Washington, D.C.: U.S. Department of Housing and Urban Development, 1971); and Kenneth L. Kraemer et al., "A Future Cities Survey Research Design for Policy Analysis," *Socio-Economic Planning Sciences* 10 (1976):199–211.

TABLE 1. CITY SIZES, 1975: USAC, NON-USAC, AND RFP

City Group	Average Population	Average Annual Operating Budget	Average Number of City Employees	Average Computing Budget as % of City Operating Budget
USAC cities[a]	205,455	67,506	2,516	3.27
RFP cities[b]	244,709	86,094	4,065	1.18
Non-USAC cities[c]	146,816	47,183	3,584	0.97

[a] Populations of the individual USAC cities were: Charlotte, 285,000; Wichita Falls, 96,000; Dayton, 214,000; Reading, 84,000; Long Beach, 347,000.

[b] Includes seventy-three of the cities that responded to the USAC request for proposals; excludes the five USAC site cities chosen, as well as St. Paul, Minnesota.

[c] Includes all URBIS cities, except the seventy-three RFP cities, the five USAC site cities, and St. Paul, Minnesota.

State of Application Development

Three measures summarize the state of application development in USAC cities: extent of automation, diversity or spread of automation across municipal functions, and sophistication of automation.

Extent of automation (table 2) is measured by the average number of computer applications operational. This number increased by 130 percent in the USAC cities between 1970 and 1975, and in the RFP cities by 168 percent. The USAC cities led the group in average number of operational applications in 1975, with forty-six, compared to forty-three in RFP cities and twenty-eight in non-USAC cities.

TABLE 2. IN 1975, USAC CITIES SURPASSED NON-USAC AND RFP CITIES IN BOTH EXTENT AND DIVERSITY OF APPLICATIONS DEVELOPMENT

	Extent of Automation			Diversity of Automation		
	Average Number of Applications Operational			Average Number of Municipal Functions Automated (32 Possible)[a]		
Cities (City Groups)	1970	1975	% Change	1970	1975	% Change
Charlotte	20	57	+185	10	20	+100
Wichita Falls	27	47	+ 74	14	16	+ 15
All-USAC cities	20	46	+130	11	16	+ 45
RFP cities	16	43	+168	8	13	+ 60
Non-USAC cities	N/A	28	N/A	N/A	10	N/A

[a] This excludes public education.

Diversity of automation (table 2) is measured by the number of municipal functions in which computing is applied. Among USAC

cities this number increased by 45 percent and among RFP cities by 60 percent between 1970 and 1975. Again, USAC cities led in number of functional areas covered in 1975 with eighteen, while RFP and non-USAC cities had thirteen and ten, respectively.

Sophistication of applications (table 3) is measured by the comparative percentage of applications in each of six information processing tasks of varying sophistication. In both USAC and RFP cities the percentage of record-keeping and calculating/printing applications decreased slightly, while the percentages of more sophisticated record searching, record restructuring, sophisticated analytics, and process control applications all increased between 1970 and 1975. Curiously, the USAC and RFP cities showed sophistication comparable to the non-USAC cities in 1975.

Unfortunately the data do not permit an assessment of the degree of application integration achieved in the USAC cities, the RFP cities, and the non-USAC cities. But our knowledge of the cities indicates that the USAC cities achieved much higher levels of integration, both within and among applications, than most other cities in the United States. This is a partial explanation for the only slightly greater degree of automation achieved by the USAC cities (see above); integrated applications are far more difficult, costly and time-consuming to design and implement than conventional independent applications. Finally, the 1975 survey counted only operational applications, and occurred before some of the final USAC applications were completed and began operating in the USAC cities.

State of Computing Capability

Changes in the state of computing capability brought to the USAC cities by the IMIS projects are indicated by three measures: technical capacity (computer hardware and software), staff size, and expenditure for computing.

Technical capability (table 4) is measured by total computing core capacity, presence of data-base management systems, and number of on-line computing terminals. The data show that Charlotte, Wichita Falls, and Long Beach moved from small, primarily batch, computer systems to large on-line systems with extensive terminal deployment and advanced data management capability. Computer mainframe capacity increased by fifty-four times in Charlotte, twelve

TABLE 3. SOPHISTICATION OF APPLICATIONS, 1970 AND 1975: USAC, NON-USAC, AND RFP CITIES

	Percentages of Application in Six Information Processing Tasks[a]											
	Record Keeping		Calculating/ Printing		Record Searching		Record Restructuring		Sophisticated Analytics		Process Control	
City Group	1970	1975	1970	1975	1970	1975	1970	1975	1970	1975	1970	1975
USAC cities	46	44	47	34	3	16	0	8	1	5	3	5
RFP cities	45	43	46	39	4	10	1	10	2	7	2	4
Non-USAC cities	N/A	36	N/A	46	N/A	9	N/A	6	N/A	6	N/A	4

[a] This characterization of information processing tasks is explained in K. L. Kraemer, W. H. Dutton, and J. R. Matthews, "City Computers: Growth, Usage, and Management," *Urban Data Service Reports* 7, no. 11 (Washington, D.C.: International City Management Association, 1975).

TABLE 4. USAC AND RFP CITIES MADE MAJOR GAINS IN COMPUTING CAPACITY BETWEEN 1970 AND 1975, AS COMPARED TO NON-USAC CITIES

	Total Computing Core Capacity			Total Number of Active Terminals		
City	1970	1975	% Change	1970	1975	% Change
Charlotte	31K	2000K	+5450	8	26	+ 230
Wichita Falls	40K	256K	+ 540	3	18	+ 500
All USAC cities	35K	1225K	+2500	4	22	+ 550
RFP cities	61K	486K	+ 690	2	20	+1000
Non-USAC cities	N/A	292K	N/A	N/A	8	N/A

times in Long Beach, and six times in Wichita Falls. Dayton and Reading both registered significant gains in computing core size, but little change in the other indicators.

Staff size (table 5) increased by 74 percent in the USAC cities

TABLE 5. USAC CITIES MADE MAJOR INCREASES IN NUMBER OF COMPUTING EMPLOYEES AND EXPENDITURE ON COMPUTING BETWEEN 1970 AND 1975, AS COMPARED TO RFP AND NON-USAC CITIES

	Average Number of Computing Employees			Average Expenditure for Computing as a % of City Operating Budget		
City	1970	1975	% Change	1970	1975	% Change
Charlotte	32	59	+84	1.3	2.6	+100
Wichita Falls	15	27	+80	2.8	6.6	+135
All USAC cities	27	47	+74	1.24	3.27	+163
RFP cities	21	31	+47	0.99	1.18	+ 20
Non-USAC cities	N/A	11	N/A	N/A	0.97	N/A

between 1971 and 1975, compared to only a 47 percent increase in the RFP cities. Staffs in the USAC cities in 1975 averaged forty-seven employees, while the RFP cities and non-USAC cities averaged thirty-one and eleven employees respectively.

Expenditures for computing (table 5) in the USAC cities, measured as a percentage of city operating budget, increased by 163 percent from 1970 to 1975, compared to a 20 percent increase in the RFP cities. In 1975 USAC cities spent an average of 3.27 percent of their operating budgets for computing, compared to 1.18 in RFP cities and 0.97 percent in non-USAC cities.

The state of computing capability in the USAC cities clearly was considerably advanced as a result of USAC, and this advance appeared in all the USAC cities. It is worth noting that these increases in computing capability greatly outshadowed analogous increases in applications development, indicating that much of USAC's re-

sources went for purposes other than fast implementation of large numbers of operational applications.

State of the Government Environment

Three impacts of the IMIS projects on the city environment can be noted. These impacts were not measured quantitatively, but were observed in visits to the cities and in interviews with key personnel from the USAC cities. First, because of time delays and the difficulties encountered in systems analysis and systems conceptualization, a number of IMIS applications were brought-up very quickly and too near the end of the projects. This created serious operational problems. Systems were not adequately debugged. Users were not well trained. Some systems were only partially finished. It has taken several years to fix up and redesign systems brought-up near the end of the projects.

Second, initial enthusiasm for the projects turned to skepticism about computer-based information systems generally when it became clear that the projects' high expectations would not be met. Substantial effort at rebuilding support for computing in the USAC cities has been required to counter this skepticism.

Third, independent study of selected applications done for USAC indicates that the IMIS projects provide net benefits for cities only if federal costs for research and development are excluded. Taken as a whole, USAC has resulted in a net cost to the cities that must be weighed against qualitative improvements, such as faster response in emergencies, easier response to citizen requests, new information available, and so forth. Cost-benefit analysis covering these factors has yet to be done.[12]

Summary

The primary impacts of USAC on the participating cities have been the expansion of computing capacity and staff size, the integration of computer applications, and an increase in the operational

12. A cost-benefit study aimed at answering questions about continuation of the USAC projects was performed by Peat, Marwick, Mitchell and Company during 1973. The report looked only at in-progress activities of USAC in Charlotte and Long Beach, and was performed too early to fully evaluate the factors discussed in this paper. See Peat, Marwick, Mitchell and Company, *Final Report: Evaluation of the USAC Project* (Springfield, Va.: National Technical Information Service, 1973).

and managerial problems of computing brought by the demands and complexities of the program. Although many of the applications envisioned by USAC planners will probably eventually be built by the cities on their own, the development and implementation portions of the USAC goals were not reached within the life of the project. In development and use of computing, the two total-systems sites seem to be ahead of cities comparable to themselves and will probably remain so due to their head start. But it is clear that all the RFP sites were among the more advanced cities in use of the technology to begin with.

These data also indicate the impact of USAC on other cities not selected as USAC sites. The fact that the RFP cities (together with USAC sites) are in all cases so far ahead of non-USAC cities is in part due to a selection bias in the seventy-nine-city sample (that is, this sample represents cities most interested in USAC, and thus likely to be more advanced in computing). But we believe it is also due in part to the influence of the USAC RFP process on those cities. The extensive RFP process tended both to focus and to mobilize computerization efforts in those cities, and this mobilization in many cases carried on even after cities were excluded from the USAC projects. Thus the phenomenon of USAC had impacts beyond its programs.

LESSONS LEARNED FROM USAC

The most expedient way of evaluating the lessons of USAC is to assess what has been learned about the seven USAC concepts for integrated municipal information systems presented earlier. We will review each concept briefly and then assess it to determine whether the concept was realized, or at least demonstrated, and what the experience indicates for others.[13]

The Concept of Total Systems and Subsystems

USAC postulated that a total municipal information system was comprised of four major subsystems covering public safety, public

13. This section draws upon our personal experience with the USAC program, discussions with USAC personnel, and the final project reports of the USAC cities. See Charlotte, N.C., *Project Completion Report* (Springfield, Va.: NTIS, 1975); Wichita Falls, Texas, *Project Completion Report* (Springfield, Va.: NTIS, 1975); Dayton, Ohio, *Final Project Report* (Springfield, Va.: NTIS, 1975).

finance, physical and economic development, and human resources development. Several important lessons on this concept can be drawn from the USAC experience. Most important, it is now clear that the scope and complexity of building a total municipal information system is greater than originally thought. Conceptualizing application components was relatively easy, but the number of conceptualized components far outdistanced the number that could be implemented during the project, as shown in table 6. Charlotte conceptualized 108 components but implemented only 15; Wichita Falls conceptualized 115 components but implemented only 17. Charlotte implemented components in all four subsystems, whereas Wichita Falls concentrated its implementation in the public finance subsystem (13 out of 17 implemented components).[14]

It is also now clear that the task of building municipal information subsystems is more manageable than that of building total systems. Dayton implemented ten out of eleven conceptualized components in the public finance subsystem, and Long Beach implemented eleven out of its seventeen conceptualized components in the public safety subsystem. These subsystem projects benefited from their limited scope, which made the projects more manageable. They also benefited from a comparatively long time-frame for development, expanded from two to five years (+150 percent), and a level of funding that expanded from about $1 million to $3 million (+200 percent). These advantages provided the flexibility and slack resources needed to deal with the unexpectedly complex R&D problems encountered. In comparison, the total system projects had only a 25 percent increase in time and a 66 percent increase in funding support. If the total system projects had enjoyed expansions similar to those of the subsystem projects, they might have had more positive results.[15]

Finally, the institutional character of the human resources development subsystem is much larger and more complex than was anticipated. The St. Paul project was doomed from the start, considering the obstacles it faced. It would have had to enlist support

14. It should be noted that Charlotte had implemented a set of major financial applications shortly before USAC, and thus chose to concentrate on other functional areas in addition to finance.

15. Time, in particular, seems to be an important component in the success of innovation efforts. See Baer, Johnson, and Merrow, "Government-Sponsored Demonstrations," p. 955.

TABLE 6. CONCEPTUALIZED APPLICATIONS FAR OUTNUMBERED ATTEMPTED AND IMPLEMENTED APPLICATIONS IN USAC CITIES

	Public Safety Con.	Att.	Imp.[a]	Human Resources Development Con.	Att.	Imp.	Physical and Economic Development Con.	Att.	Imp.	Public Finance Con.	Att.	Imp.	Total Con.	Att.	Imp.
Charlotte	17	12	5	33	2	1	38	6	6	20	7	3	108	27	15
Wichita Falls	21	3	1	35	4	0	47	19	3	12	31	13	115	57	17
Long Beach	17	11	11	–N/A–			–N/A–			–N/A–			17	11	11
Dayton	–N/A–			–N/A–			–N/A–			11	8	10	11	8	10
Reading	–N/A–			–N/A–			36	15	5	–N/A–			36	15	5

SOURCE: Comparison of various project reports from the systems conceptualization phase and the systems implementation phase with the final project report for each city.

[a] Con. = conceptualized; Att. = attempted to implement; Imp. = actually implemented.

and cooperation from over 150 public and private agencies providing human services in the city. It would have encompassed a great many human services functions outside the city government's legal jurisdiction, including education, which by itself was an activity as large and complex as the city government. And it would have had to manage this morass through the mechanism of the local consortium, which in itself was sometimes unmanageable.[16] When USAC discontinued the St. Paul project it placed emphasis on human resources development in the total system projects. Yet out of the thirty-three human services components conceptualized in Charlotte, only one was implemented. Wichita Falls conceptualized thirty-five and implemented none.

The Concept of Integrated Information Systems

USAC considered integration to be the key in developing total municipal information systems. Two kinds of integration were proposed: operational integration, which would link logically related municipal processes normally divided by organizational or other barriers; and data integration, which would link nearly all municipal data to facilitate their use for both operations and management.

At the time USAC started it was not clear whether such integrated systems could be built, so the USAC projects were in effect experiments to find out. Thus the first and most significant lesson learned on this issue was that integrated information systems can be built. Charlotte, for example, made major progress in integrating use of certain data across municipal departments. These accomplishments include integration of data on building characteristics for use by both the building inspection department and the fire department; integration of land parcel data for use by the fire, planning, building inspection, and public works departments; and integration of data on municipal rolling stock for use by the finance, fire, police, and public works departments.[17] Wichita Falls also made substantial

16. See *Human Resources Development Subsystem: Final Project Report* (St. Paul, Minn.: City of St. Paul and Aires Corporation, 1972); and Doug Hines, "St. Paul Subsystem: Anatomy of a Failure," *Urban and Regional Information Systems Association Conference Proceedings,* 1972, pp. 265–279.

17. See Joseph R. Motto, "Data Base Management in the Charlotte Municipal Information System: A Post-USAC Update" (Paper presented at the 1977 Annual Conference of the Urban and Regional Information Systems Association, Kansas City, Mo., August 1977).

progress toward the goal of an integrated total system, and Long Beach and Dayton both built successful integrated subsystems.

The degree of integration accomplished in USAC fell far short of expectations, however. This fact brings up the other major lessons about integrated information systems learned from USAC. Experience has shown that the operational meaning of the USAC concept of integration is much more complex than anticipated.[18] USAC assumed that integration would be achieved rather simply by developing a few large data bases oriented around people, property, money, and personnel, and by linking them through common identifiers such as name, social security number, and property geocode. Real integration is technically more difficult to accomplish. The number of data bases actually required is five to ten times the number anticipated by USAC, because the operating departments have differing demands regarding data security, hours of access, response time, backup, rapid recovery in the event of failure, and costs they can afford. The greater the number of data bases, the greater the difficulty of providing linkage among them.

Integration also is difficult to accomplish because of several features of organizations. First, systems and operations are already linked. Systems are embedded in day-to-day operations; they are not merely adjuncts to them. People come to depend on systems, so problems with systems have both personnel and performance implications. Integration increases the complexity of systems, raising the propensity for problems. Second, some data integration already takes place in most organizations, but along established paths, either formal or informal. Imposing a new standardized data-sharing regimen not only entails implementation of new procedure, but disrupts existing procedure and practice. Thus integration can only be accomplished if complex existing relationships among data providers and users are acknowledged and taken into consideration in a new integration plan.

Another lesson is that building integrated systems takes considerably more effort, time, and money than previously thought. The Dayton financial system illustrates the difference between planned

18. *Ibid.* See also Donald Luria, "Success Depends on Transferability," in *Urban and Regional Information Systems: Information Research for an Urban Society* (Claremont, Calif.: URISA, 1973), vol. 1, *Papers from the Eleventh Annual Conference of URISA, August 28–31, 1973,* pp. 186–93; and Hemmens, "Integrated Municipal Informations Concept."

and actual resource requirements for an integrated subsystem. It is a particularly good example because it encompasses nearly all the components of the finance subsystem and because all of them have been built. As table 7 shows, the Dayton subsystem took five times

TABLE 7. ACTUAL RESOURCE REQUIREMENTS FOR BUILDING THE DAYTON FINANCE SUBSYSTEM FAR EXCEEDED PLANS

Resources	Amount Planned	Actual Amount Spent[a]	Overran
Person-years effect	13.5	67.0	+396%
Elapsed time to completion (years)	2.0	5.0	+150%
Cost (in millions of dollars)	1.5	2.9	+ 93%

[a] Represents cost in federally supplied money only.

the planned effort (67 versus 13.45 person-years), two and one-half times the planned time (five versus two years), and one and one-half times the planned cost ($2.9 million versus $1.9 million). The approximate per capita cost for Dayton's subsystem, $11.64, is high compared to $2–3 for "basic" finance systems developed by other cities (see table 8). Differences in capabilities of the systems, and

TABLE 8. COST FOR CITIES WITH FINANCIAL SYSTEMS OF COMPARABLE "BASIC" COMPREHENSIVENESS

City	Population	Approximate System Cost ($)[a]	Approximate Cost per Capita ($)
Rockville, Md.	45,000	100,000	2.20
Fresno, Calif.	190,000	750,000[b]	3.94
Dayton, Ohio	245,000	2,900,000	11.64
Detroit, Mich.	1,200,000	2,500,000	2.10
New York, N.Y.	7,750,000	24,000,000	3.10

SOURCE: U.S., Department of Housing and Urban Development, *Fiscal Management Capacity Building* (Washington, D.C., 1976).

NOTE: All cities contain at least four basic capabilities: payroll, ledger and journal accounting, purchasing, and budget functions. Dayton's system goes considerably beyond the four basic functions.

[a] New York's costs are only for contractors and are estimates since the project is not yet complete. The other cities' costs include some internal personnel costs. Fresno and Dayton costs are based upon detailed accounting for both direct and indirect costs.

[b] These costs include the transfer contract plus Fresno's in-house staff costs; based on a telephone conversation with Dan Nolan, City of Fresno, August 1977.

the additional costs of R&D for Dayton, contribute to this difference. It is significant to note that Fresno, which transferred the entire Dayton subsystem, spent only 25 percent of Dayton's development cost to transfer and install the system (table 8).[19]

19. Dayton, Ohio, *Project Completion Report.*

The final lesson learned about integration is that the technology to support full integration is sophisticated and costly. The technological package necessary to support a fully integrated information system as envisioned by USAC includes a third-generation, or later, computer (or computers) with minimum core capacity of 500 kilobytes and on-line storage of at least eight megabytes; complex data base management software costing as much as $20,000 per year to rent; sophisticated telecommunications capability; a data base administrator and systems programmer to handle data base activities; extensive data base documentation; and policies and procedures for data standardization. This package is generally within the reach of only the larger, more experienced cities, indicating that the potential number of cities that could develop fully integrated systems is limited at present. New advances in technology may in time change this condition.

The Concept of Operations-Based Automation

USAC proposed that data needed for municipal planning and management be gathered through ongoing data collecting activities of government operations. Earlier experiments with planning and management data banks had shown that data banks were difficult to keep updated, and that municipal planning and management functions alone could not justify the large front-end costs to develop these data banks. Operations-based, integrated systems offered the promise of economic data collection plus reliable and continuous updating.

USAC showed that planning and management data can be generated from integrated, operations-based systems. By using data from operating files on properties, building use, streets, utilities, municipal service delivery, and project costs, linked together according to geographic indicators such as blocks, census tracts, neighborhoods, political districts, and street segments, Wichita Falls has been able to conduct neighborhood analysis, determine the boundaries of urban renewal projects, select sites for municipal facilities, determine need for housing and conservation projects, prepare data for federal grant applications, handle zoning and subdivision requests, prepare city maps, and build its capital budget.[20]

The other major lesson on operations-based automation is that the presence of data is only one criterion for successful management

20. See Wichita Falls, Texas, *Project Completion Report.*

and planning data uses. The examples cited above are impressive, but they do not approach the uses of operations-based data predicted by USAC. The primary reason for this is that both planning and management lack the analytical staff needed to make extensive and imaginative use of the data. Top managers and department managers often are unaware of the data capabilities that exist. The other impediment to widespread planning and management use of operations-based data is the difficulty both managers and planners face in keeping track of the data available, ensuring that the data are current, and massaging the data to produce information. Top managers in particular are very constrained for time in most cities, so they will have a tendency to forego the possible benefits from using operations-based data for decision making if much time is required to assemble, verify, and massage the relevant, available data.[21]

The Concept of the Prototype Development Process

The USAC prototype development process included six steps: systems analysis, systems conceptualization, systems design, systems development, systems implementation, and systems evaluation. The analysis through development steps were to be performed comprehensively and simultaneously for all components of the system, with implementation and evaluation following incrementally according to established priorities. This process was intended to ensure that the information requirements, the precedence ordering, the costs and benefits, and the technical requirements of all applications would be known before implementation priorities were set. The first lesson learned here was that across-the-board movement from systems analysis to systems development does not work. It proved to be cumbersome and costly and precluded the chance to get things implemented early in order to demonstrate benefits from the system. The mass of detailed data the cities collected during analysis and conceptualization was simply overwhelming, and the analysts came to consider these tasks wasteful of resources.[22] Moreover, this

21. Steven Ondraegus, "Urban Planning in Wichita Falls, Texas: One Year After USAC," *Urban and Regional Information Systems Association Annual Conference Proceedings* (Claremont, Calif.: URISA, 1976), pp. 292–300.

22. K. L. Kraemer et al., *Systems Analysis in the USAC Cities* (Washington, D.C.: U.S. Department of Housing and Urban Development, 1972).

approach failed to recognize the learning benefits that accrue from early experience with the complete system-building process. The cities abandoned the across-the-board approach early, set their priorities by intuiting, and set to work designing and developing the applications they actually planned to implement.

Another important lesson was that users must be considered more carefully in the process. It was found that users must adapt to each new increment before the next is implemented. In order to meet user needs satisfactorily, every implementation effort requires training and hand-holding of users and design modifications beyond what are originally anticipated. Also it was demonstrated that user involvement is extremely difficult to maintain with a protracted prototype development process. Key department personnel most valuable to the system building effort also were valuable to their departments, to whom they owed first allegiance; a situation that eventually made them unavailable. Added to the normally high incidence of departmental staff changes through promotion and turnover, this fact made it nearly impossible to sustain the necessary user involvement and interest in the process.

Finally, USAC showed that underlying precedences in developing prototype systems must be acknowledged. Integrated systems require that certain system components be developed and implemented before all others, since they act as foundations for the other systems. In USAC these systems were the geographic base file, the basic general ledger accounting system, and the basic personnel/payroll system. Although the USAC concepts recognized this notion of precedence relations, the prototype development process originally proposed did not take this into account, and the projects found it necessary to abandon the process model to make progress on these basic components. Once these were implemented, further development and system integration tended to occur through opportunistic evolution as much as through careful planning.

The Concept of Complete Documentation

USAC hoped to facilitate development and transfer through complete, careful documentation. Unfortunately, the excessive documentation requirement backfired. The tedious burden of documentation was onerous to the analysts, delaying their progress toward design and implementation, and actually made transfer more dif-

ficult. Taken together, USAC project documentation fills about seventy-two linear feet of shelf space. This sheer volume is a barrier to transfer because there is neither an interpretive guide to the mass of volumes nor a synthesis of what was built and what was learned.[23]

The Concept of Systems and Subsystems Transfer

The "bottom line" of the USAC program was supposed to be achieved when the prototypes were transferred to other cities, thereby advancing the state of information systems in cities by a whole generation.[24] Widespread transfer would justify the cost of the program several times over. Despite this dream, not much physical transfer of USAC application software has occurred. There has been interest in transfer as expressed by inquiry visits and by requests for complete project documentation, but to date there are only fifteen known transfers from the whole project, with seven involving Dayton's finance subsystem (see table 9). There has been no transfer of one of the total systems to another city.[25]

TABLE 9. THERE HAS BEEN LITTLE INTEREST IN TRANSFER OF USAC SYSTEMS

	Charlotte	Wichita Falls	Dayton	Long Beach
Number of visits by other cities	39[a]	2	38	2
Number of cities receiving documentation	–	2	14	2
Number of known transfers of one or more components	4	2	7[b]	2
Number of known transfers of total system or subsystem	–	–	1	–

SOURCE: Project completion reports and telephone conversations.

[a] Charlotte had a total of sixty-seven outside organizations visit the project with transfer interests; some visited more than once.

[b] These places transferred part or all of the finance subsystem.

23. Two bibliographies have recently been released that may help provide guidance to the stack of USAC materials: Public Technology, Incorporated, *Index to Municipal Information Systems Publications* (Washington, D.C.: U.S. Department of Housing and Urban Development, 1976); and Mary Young, *Urban Information Systems: A Bibliography with Abstracts* (Springfield, Va.: National Technical Information Service, 1977).

24. Our use of the word *transfer* is fairly liberal. We take *transfer* to refer to any movement of a technological development to another use or to the same use in another setting. This contrasts with Baer, Johnson, and Merrow ("Government-Sponsored Demonstrations," p. 952), who use *transfer* for the former case and the word *diffusion* for the latter.

25. More transfers than this may have occurred, but we have been unable to get data indicating this is the case.

A major lesson from USAC is that integration makes transfer especially difficult and problematic.[26] There are several reasons for this. First, integrated applications are larger than normal applications. For example, the Long Beach public safety subsystem contains 146 programs. Systems of such size and complexity simply are too difficult for many cities to adopt. Advanced technical capabilities and staffs required for integrated systems may not be available in many cities. Second, integrated systems must be transferred substantially in whole. Cities cannot simply select the parts of the system they would like to transfer, because the components are designed to operate as a system. This places a cost burden on those transferrees that must implement more than they actually need. Finally, as integration increases so does the need for city agencies to share data, to provide data needed by other agencies, and to agree to collect data only once at the most logical place. If city agencies are unwilling to cooperate, transfer potential is lessened.

Transfer is more feasible when applications are small, standard, simple, and somewhat independent. This is suggested most clearly by the experience with transfers of the Dayton finance subsystem. The Dayton subsystem is a relatively simple batch system with clearly defined and separable modules, and in part as a result of these characteristics the subsystem has been transferred as often as all the other systems combined. Even allowing for the popularity of finance applications, the Dayton transfer experience overshadows those of the other USAC cities.

The Concept of the Consortium Approach

USAC's consortium approach, which was based on the systems model of management in defense and aerospace industries, assumed that proper planning, management, and control would unite a diverse group of people and organizations and get them to produce a single, unified product. In fact, the consortium arrangement was fraught with problems, and eventually dissolved. The USAC Committee drifted apart two years before the USAC projects ended, the

26. Further discussion of problems inherent in computer application transfer can be found in K. L. Kraemer, "Local Government, Information Systems, and Technology Transfer: Evaluation of Some Common Assertions about Application Transfer," *Public Administration Review* 37 (July/August 1977):368–82; Hemmens, "Integrated Municipal Informations Concept"; and Luria, "Transferability."

federal administrator of the USAC program changed four times in six years, the universities never became viable members of the local consortia, and the interconsortium panel was discontinued after only two years.

The major lesson on this from USAC is that the systems model of organization may be inappropriate for such inherently complex efforts that involve people and organizations with conflicting goals and interests. The federal agencies purported to support USAC because of their interest in improving local governments. In fact, each agency had quite different expectations, incentives, and levels of commitment. Consequently, they withdrew their support when the cities' definition of improvement proved to be different from their own. The cities purportedly were interested in developing systems that would meet both federal and local data needs and that would serve as prototypes for other cities to adopt. In fact, the cities were interested only in their data needs and in development rather than in research into prototypes. This created continuous federal-local tension over project objectives.

The local consortia also had difficulty cooperating. The cities wanted the systems tailored to local needs; the consultant firms wanted to develop generalized systems appropriate for commercial transfer to other cities. The cities were supposed to be in charge, but they lacked the technical expertise. Thus the systems firms made nearly all technical decisions and many substantive decisions as a result of these technical choices. The consortium arrangement placed the universities in a double bind. The universities were supposed to be both friendly inside advisers and objective outside critics. Yet the cities and the systems firms were reluctant to make the university teams privy to inside information when as outside critics they could easily use inside information against the project staff. The universities were forced to choose either the advisory or the critical role. The critical role shut the university out of project affairs, while the advisory role precluded candid criticism.

Perhaps the underlying reason for the problems that plagued the consortia was the unfailing belief of USAC officials in the consortia model and their rigid adherence to it in spite of its failings. Conflicts and problems were thought to be due to human failings and institutional rigidities among the consortia members rather than due to

the possible inappropriateness of this aerospace model for organization.[27]

THE SYSTEMS APPROACH REAPPRAISED

USAC's administrative structure, its research and development processes, and its concepts for IMIS were all based upon what is often called the systems approach.[28] This concept so pervaded USAC that a better term for it would be "systems consciousness." Systems consciousness is predicated on a basic faith in technology and the belief that technological progress is best accomplished through a systematic research, development, and implementation effort. In the aerospace industry, where USAC found many of its roots, systems consciousness is characterized by the use of large-scale federal funding for research and development of advanced technology to demonstrate through prototypes the potential benefits from full-scale application of this technology and, thereby, to stimulate widespread diffusion and use of the technology.[29] In USAC,

27. See George Hemmens, "The Consortium Model and Evaluation Research Design in USAC," in *Urban and Regional Information Systems Association Proceedings* (Claremont, Calif.: URISA, 1973), pp. 283–97; and Barry Wellar, *USAC Experience.*

28. The term *systems approach* can refer to three aspects of civilian problem solving, which we call technical, analytical, and procedural. Technical solutions are developments of hardware or software that answer particular, circumscribed problems: how to heat a building with less energy, how to find buried pipes beneath city streets without digging them up, how to pick up garbage from curbsides mechanically. Analytical solutions are applications of predictive and quantitative analytical techniques to answering questions about the present or the future. These have been most widely seen as the various simulation and modeling efforts that have been applied to urban growth, housing, transportation, utility planning, and logistics management (such as vehicle routing). Procedural solutions are applications of the methodology of the systems-oriented agencies that have resulted in successful mission accomplishment from goal definition, through development and manufacturing, to deployment and adoption. USAC is an example of the technical and procedural aspects of application of the systems approach: technical, in that computer technology was to break down bottlenecks in flow of information from source to end users; procedural, in that design, development, and deployment of the systems would take place through the systematic methodology used successfully in the aerospace industry.

29. We speak here of government-sponsored research and development in aerospace, not projects funded with private capital, such as civilian aircraft and private satellite development. However, much of the technology that goes

the technology was computing, the advanced application was IMIS, and the targets for diffusion were cities.

Two main assumptions of systems consciousness were found in USAC: that it is possible to build from scratch totally new, full-scale systems that will be effective but not necessarily cost-effective for the initial development sites; and that, once built, the effectiveness of these systems will be so great that they will be widely transferred at reasonable cost and thereby achieve cost-effectiveness for the original R&D investment. The experience of USAC suggests that these assumptions were too simplistic. USAC failed to develop the large-scale, integrated, operations-based municipal information systems it conceived.

Three explanations can be offered for this failure. First, it can be argued that the systems approach simply does not work as purported in any situation. This is not a particularly compelling argument, since there are many examples of application of the approach that have achieved remarkable success. In particular, the organization of the American manned spaceflight effort leading to the moon flights stands out as a notable accomplishment in use of the systems approach.

A second and more reasonable explanation is that the systems approach works well only in the comparatively straightforward environment of aerospace hardware development or of other explicitly technical tasks.[80] When the prototypes for development are physical

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into civilian and private sector aerospace activity is usually developed out of military and national space programs anyway. Non-aerospace applications of this model can be seen in numerous cases: the development of the nuclear freighter Savannah; the mechanized refuse collection machine Godzilla in Scottsdale, Arizona; the fast breeder reactor program; personal rapid transit system demonstration at Morgantown, West Virginia; and various experimental waste processing facilities, to name just a few. See Rand Corporation, *Analysis of Federally-Funded Demonstration Projects: Final Report* (Santa Monica, Calif.: Rand Corporation, R–1926–DOC, 1976).

30. There has been a good deal of debate about the efficacy of the analytical aspect of the systems approach in dealing with social or administrative problems. Rational, systems analysis applied to policymaking had its heydey in the mid-1960s, began to wane in the late 1960s and early 1970s, and has undergone a series of ups and downs since, drawing criticism and praise, depending on the bias of the commentator. For further reading assessing the applications of systems analysis, rational analysis, and policy analysis to social problems, see Richard Nelson, "Intellectualizing About the Moon-Ghetto Metaphor: A Study of the Current Malaise of Rational Analysis of

systems such as aircraft or spacecraft, the objectives are relatively clear and the requirements for development can be agreed on by all concerned. There is much history and existing knowledge to draw upon. More important, there is usually only one client (the federal government), for the products of these systems, and more often than not the client is a single agency with clear expectations for its programs and well-developed relationships with its contractors. The USAC projects, on the other hand, took place in a complex environment involving federal government, local government, consulting firms, and universities. The prototypes for development, although rationally described in concept, entailed a great number of unknowns, and there was no history or experience to provide assistance. Objectives varied among the participants, and even the cities vacillated in their desires for what the end product should look like. There was no unifying and directing force such as a single client, so it was impossible to center the activities of USAC sufficiently to allow the systems approach to function. Without a systematic and stable environment in which to operate, the systems approach was doomed.

The final, and perhaps most important, explanation for the failure of the systems approach in USAC is insufficient resources. *Resources* here refers primarily to money, but other resources such as technical assistance and high-quality staff are important as well. The *major* difference between the environment of federally funded aerospace development and federally funded development in municipal information systems is not organizational and not technical; it is financial. The systems approach works well in aerospace in part because it has been given every opportunity to succeed. USAC spent $26 million over seven years to develop prototype information systems to link together local government data for use in planning, management, and operations. Congress allocated $462 million for 1978 alone to continue work on the prototype of the B–1 bomber, and that is only one project out of hundreds over the past forty

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Social Programs" *Policy Sciences* 5 (1974):375–414; Ida Hoos, *Systems Analysis in Social Policy: A Critical Review* (London: Institute of Economic Affairs, 1969); C. West Churchman, *Challenge to Reason* (New York: McGraw Hill, 1968); and Gary Brewer, *Politics, Bureaucrats, and the Consultants: A Critique of Urban Problem Solving* (New York: Basic Books, 1973).

years.[31] We do not intend to criticize the aerospace industry or the military, but to point out the enormous difference in resources that separates projects like USAC from the projects they are modeled after. If USAC had been provided a proportional level of funding equivalent to that provided projects in defense and space, it might have had a very different set of outcomes. Unfortunately, it is impossible to know at this point.

CONCLUSIONS

From a technical standpoint, the USAC program demonstrated a mix of shortfalls and accomplishments, like nearly all large and innovative projects. We have explored examples of both. The shortfalls of USAC are significant. USAC did not succeed in its goal of developing and transferring complete, integrated municipal information systems. The concept of an integrated municipal information system proved to be an elusive and difficult concept to bring into reality. What began with great ambition ended with automation and integration of some municipal operations and marginal contribution to municipal planning and management. In this respect USAC is not unique among ambitious programs either at the local or at the state and federal levels.

On the other hand, USAC accomplished more than a cursory glance might reveal. USAC demonstrated that integrated systems can be built. It also demonstrated that operations-based systems can effectively provide data for planning and management. And obviously, the USAC projects themselves had a profound impact on development of computing in the USAC site cities. But another impact of USAC is not commonly recognized. This is the fact that

31. The total civilian R&D federal budget for 1978 is, by comparison, $8.6 billion. The paucity of funds granted to accomplish very ambitious projects is discussed in Roland L. Warren, Stephen Rose, and Alan Bergunder, *The Structure of Urban Reform* (Lexington, Mass.: Lexington Books, 1974), p. 172. We feel it appropriate to note that some critics of USAC, participants in the program, have argued in discussions with us that the funding for USAC was sufficient but misapplied. The problems, they assert, were that the money was too spread out (that is, it may have been better to place $26 million in one or two sites), and that the "best" sites were not chosen for development. The former seems a restatement of our conclusion; the latter, of course, cannot be evaluated since it is not clear at this point that any of the applicants for the grants had categorically superior capability. And if they had, they probably would not have been appropriate as demonstration sites for promoting diffusion.

USAC dramatically changed the way many local governments conceived of their information systems, and this change is reflected in the directions that continue to appear in the field. This is true not only in the USAC sites, but in many of the cities that originally responded to the USAC RFP and in cities that had nothing to do with USAC. The concept of integrated municipal information systems significantly influenced subsequent information systems development in local governments in the United States and in some cases abroad.[32] The USAC concepts for IMIS continue to appear in documents about existing and proposed systems in cities that never were formally connected to USAC. Thus the most significant accomplishment of USAC was its impact as a catalyst and a vision for the general development of urban information systems in the United States.

Beyond its technical aspects, USAC was a political and cultural experiment, and its failure in this regard may be its most important failure, from a policy perspective. Politically, USAC was an attempt to get cities to solve a problem the federal agencies had been unable to solve themselves, despite a decade of individual agency experimentation with functionally oriented information systems. The problem was developing flexible and comprehensive systems that would support continually changing intergovernmental needs for information used to justify, plan, manage, and evaluate federal urban programs. The federal strategy was to "push" reform of local government information systems by supplying standard prototypes that all cities could adopt. Once adopted nationwide, these systems would not only serve federal information needs. The federal agencies would encourage adoption of the systems by establishing information standards for the local governments to meet and by providing financial incentives for the local governments to adopt the prototypes that would meet the standards.

The federal strategy broke down, however. The prototypes proved more difficult, costly, and time-consuming to develop than anticipated, thus discouraging both the cities, with their short-term objectives of improving information management, and the federal agencies, with their long-term objectives of developing effective intergovernmental information sharing networks. The demand for

32. This conclusion is based on a review of conference proceedings of the Urban and Regional Information Systems Association (URISA) since 1970 and on interviews conducted by the authors in forty-two cities.

systems to assist in integrated information management in local governments, although real, was far too weak to pull further development along once the high cost and long time-frame for prototype development became apparent. And the concept of integrated systems itself proved to have detractors as well as promoters, once the likely political effects of integration of information within cities and between governmental levels became visible on the horizon.

Culturally, USAC was an attempt to mesh widely divergent expectations, incentives, and levels of commitment among federal, local, and private agencies to support and implement its strategy. Like the political experiment, the cultural experiment failed because of serious miscalculations. Simultaneous involvement of so many agencies with such divergent interests proved unworkable. Most of the federal agencies were interested in the downstream effects of the IMIS projects on intergovernmental information flows, and they became extremely impatient with the implementation problems of the cities, which delayed the achievement of these effects. Local governments were interested in the immediate effects of the projects on cost-efficiency within departments where the technology was applied, and they became frustrated with the impacts of continual development time extensions on cost-efficiency gains.

The private software development firms were interested in the potential of the projects for commercial transfer elsewhere, and they felt their interests being thwarted as the cities pressed them for immediate, tailored results that reduced the potential for commercial transfer available from generalized designs. Also, the withdrawal of active support by federal agencies signaled to the private firms the lessened likelihood of funding for nationwide transfer of the prototypes. Given limited resources of all kinds (knowledge, skilled people, time, money) the divergent interests of the various agencies could not be met within schedule. Moreover, the governing mechanisms of USAC—the federal consortium, the local consortia, and the interconsortium panel—all lacked the means of ameliorating the differing interests and developing consensus about more focused goals. Divergent agency goals also meant that concepts of project success varied widely, making evaluation of project status problematic and dependent upon who one talked to. Evaluating the *objective* status of the projects proved difficult, which tended to focus evaluation efforts on a single criterion that everyone could agree upon: "Are the systems getting built?"

Thus the narrow goal of completing the IMIS modules became the focus of the USAC program, and this goal was less than satisfactory to all parties. It coincided with the interests of the local contractors who were struggling to complete their part of the emaciated program, but it did not serve the interests of the federal agencies that had initiated the broader USAC program in order to meet their own goals. When the goals changed, the interest and involvement of nine of the federal agencies waned, leaving HUD to close-out the program.

Policy Implications

Considered as an example of public policy in the development and diffusion of new technology applied to intergovernmental problems, USAC yields several policy lessons. First, and in keeping with other findings about federally sponsored demonstration projects, USAC demonstrated the difficulty of encouraging development and diffusion of innovation simply through supply-push strategy. Before USAC and since, local governments have developed computing applications largely on their own, in response to their own perceptions of need, and in their own increments. The IMIS concept, while intriguing and still promising, was such a dramatic departure from this traditional development pattern of local governments that it was difficult for them to adapt. Also, while the need for more effective information management technology is obvious in the general sense, local governments differ considerably from one another, depending on size and locality. Thus a specific package of information management technology is not likely to be in universal demand. Future federally sponsored efforts to develop transferable technology for use in local governments should be predicated on well-researched and understood demand characteristics of the local government market.

Second, USAC's strategy of combining very basic research and advanced development should be avoided. USAC intended first to delineate all the information systems flows in a city and then to design an integrated system to manage and coordinate those flows. The task of defining all the information flows in itself proved to be a major undertaking, and the results of that task indicated that some of the grandiose concepts of IMIS simply were not possible, not practical, or not yet understood. Yet the purpose of this research was to provide the framework for design, not to call the overall plan

into question. Thus development proceeded in spite of the newly discovered magnitude of the task and the uncertainty of success. Future projects of this character should be preceded by careful, objective, and sufficiently funded feasibility studies before any efforts at systems analysis and design begin.

Third, it should now be apparent that all highly technological innovation-development efforts are expensive—usually much more expensive than anticipated. USAC's money was not only inadequate to its task, but was spread out over six sites, thus losing any economies of scale that might have been available. Although it is true that simply throwing money at major problems will not solve them, it also is true that major problems cannot be tackled successfully without sufficient funds. Future projects of this kind should be preceded by much more detailed analysis and projection of likely costs, taking into account the past experiences of other development projects that are fraught with missed deadlines, overruns, and organizational problems. Perhaps a multiplier should be applied to all final estimates, simply to provide an indication of possible final costs if things do not go well.

Finally, more care should be taken in constructing the political and organizational mechanisms that support such programs. Obviously no agency will be involved in a program in which it sees no payoff for itself or in which it has no mandate to perform. Projects and the organizational arrangements used to execute them must be formulated in a manner that allows development of clear statements of each party's expectations, and the timetable within which those expectations are to be met. Then the programs should be organized in such a way that each party's interests become individual goals that are the responsibility of the overall organization. Without such an arrangement, the potentially valuable consortium arrangements of USAC will never stand a chance. As soon as the goals of the program are narrowed or obscured, those who feel disenfranchised will abandon the effort and leave it without support or direction.

It is not our intention to argue that organizational innovations for managing federal-local programs, the consortium approach in particular, are to be avoided. On the contrary, we feel that much can be gained from experimenting with ways to integrate various agency and government interests in single programs. Much more attention must be paid to maintaining the interests of the various participants,

however. While problems existed within the local consortia and in the implementation of IMIS, these could have been worked out with time and resources. The real failure of USAC was the failure of the federal member agencies—the USAC Committee—to find a basis for continuing to cooperate in implementing the program they had jointly initiated. The USAC program was a house of cards, heavily dependent on the leadership, support, and planning of the USAC Committee. When the committee collapsed, the whole USAC program was doomed to collapse as well.