

SURVEY OF PLANNING AGENCY EXPERIENCE WITH URBAN DEVELOPMENT MODELS, DATA PROCESSING, AND COMPUTERS

GEORGE C. HEMMENS *

This paper is a report on a small survey of planning agencies on the subject of the use of urban development models and data processing in their operations. Questionnaires were sent to 34 planning agencies. The agencies were selected to include the metropolitan area land use and transportation planning agencies in the 25 largest SMSA's and selected city planning agencies of the central cities within these SMSA's. Where more than one metropolitan planning agency exists in a single SMSA, the questionnaire was generally sent to only one agency. In these instances the agency selected was the one having responsibility for comprehensive transportation planning. Similarly, no claim is made that the survey is representative of the use of models and data processing in urban or metropolitan planning agencies in general. Rather, the survey results should be viewed as representative only of the agencies interviewed.

The survey was designed to provide the following kinds of information on the use of models and data processing: description of models used including source of model, input requirements, output from model, computer usage, and agency use of model; evaluation of use of models including appropriate purpose of models, responsibility for model development, responsibility for model operation, problems in using models, and benefits from using models; experience with data processing including agency operations using EDP, EDP equipment and usage, and maintenance of data systems (or data banks); and evaluation of agency experience including agency problems and benefits, and plans for expansion of EDP operations.

Replies were received from 26 of the 34 agencies surveyed. All 26 agencies indicated either current or planned use of data processing and computers in their agency's operations. Twenty of these agencies are currently involved in the use of data processing. The other six agencies are planning or developing data processing capability. Sixteen reported on either current usage or active development of models, and 3 other agencies reported definite plans for the use of models in their programs.

* Associate Professor of City and Regional Planning, University of North Carolina at Chapel Hill

The 26 agencies include 16 metropolitan or regional planning agencies, 6 city planning agencies, 2 state agencies, 1 federal agency, and 1 consulting firm. The agencies are listed in Table 1.

In the discussion of survey results that follows, an attempt is made to summarize the individual agency replies and to interpret agency comments where possible. At this point a caveat is necessary. It is very difficult to summarize or generalize the individual agency responses. The survey results clearly show that each agency's operation is in some sense unique and that its answers to the questions posed in the survey are conditioned by the experience within that agency. Since the survey results themselves do not provide detailed information of the history and circumstances of each agency, the summarization which has been done is based on fragmentary, incomplete knowledge and is a perilous exercise. In addition, the agencies are varied in the scope and nature of their planning responsibilities. Also the agencies are of varied staff size and budget, and thus have unequal resources for data processing operations.

TABLE 1 PLANNING AGENCIES RESPONDING TO SURVEY

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- 1 Baltimore Regional Planning Council
 - 2 Bay Area Transportation Study Commission
 - 3 Chicago Area Transportation Study
 - 4 Cleveland-Seven County Land Use and Transportation Study
 - 5 Colorado Department of Highways (Denver Area Transportation Study)
 - 6 Delaware Valley Regional Planning Commission
 - 7 Denver City Planning Commission
 - 8 Detroit Regional Transportation and Land Use Study
 - 9 Eastern Massachusetts Regional Planning Project
 - 10 East-West Gateway Coordinating Council (St. Louis)
 - 11 Houston City Planning Department
 - 12 Los Angeles City Planning Department
 - 13 Metropolitan Washington Council of Governments
 - 14 Milwaukee Department of City Development
 - 15 New Orleans City Planning Commission
 - 16 New York State Department of Public Works (Subdivision of Transportation Planning and Programming)
 - 17 Ohio-Kentucky-Indiana Regional Transportation Study (Cincinnati)
 - 18 Northeast Corridor Transportation Project
 - 19 Puget Sound Regional Transportation Study
 - 20 Regional Plan Association (New York)
 - 21 San Diego City Planning Department
 - 22 Southeastern Wisconsin Regional Planning Commission
 - 23 Southwestern Pennsylvania Regional Planning Commission
 - 24 Tri-State Transportation Commission (New York)
 - 25 Twin-Cities Metropolitan Area Planning Commission (Minneapolis-St. Paul)
 - 26 Alan M. Voorhees and Associates
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The agencies are also at differing stages in their work program. Some are relatively new; others are continuing programs which have been through a peak analysis effort; and still others are in midstream. All of these cautionary remarks are inserted here as a warning to the reader that this is not a definitive survey, and that the results should not be generalized to a larger universe of planning agencies. A further purpose of these remarks is to request the reader's indulgence for errors of interpretation and assistance in setting the record right.

USE OF URBAN DEVELOPMENT MODELS

Nineteen agencies reported on urban development models in their past, present, or future. For 3 agencies the models are sufficiently far in the future that precise descriptions are not possible. The other 16 agencies have provided descriptions of their models. Some of these are operational, some are under development, and some are in the planning stage. Since existing urban development models are being very adequately summarized and analyzed in other papers for this Conference, no attempt will be made to summarize these models here. However, the agencies' description of their models, where provided in response to specific questions in the survey, are given in Appendix A.

Seven agencies indicated that they do not now use and do not have definite plans for using urban development models in their work. Five of these are city agencies (of the 6 city agencies responding to the survey). The other 2 are a state agency and a metropolitan/regional agency.

The 14 agencies responding to a question on the appropriate purposes for the use of models in planning split about two to one in giving the use of models for analysis and evaluation of policy alternatives as the major purpose. The minority view gives forecasting and analysis as the major purpose of using models in planning. A few of the agency comments serve to illustrate the majority view

Models should be used "to simulate the consequences of selecting actions, and to dimension a general plan and make it internally consistent."

Models should be used "to predict the effects of varying policy sets on certain factions of the urban system considered to be significant and predictable"

Models should be used "to forecast the effect of alternative courses of action on land development, and the effectiveness of urban systems such as water and sewer."

Models should be used "when and where they can sharpen up or illustrate consequences of following certain development policies more rapidly and/or more objectively than other procedures."

The minority view stresses the analytic capabilities of modeling. This view is also best expressed by the comment of one of the agencies.

Models can and should be used for any number of purposes in urban planning; since they are simply constructed for simplifying and systematizing the tremendous variation in the phenomena of reality such that it can be understood, controlled or resynthesized.

Regardless of whether stress is placed on the use of models for evaluation of policy or on the use of models to improve analysis and forecast of urban systems, all respondents are essentially concerned with using models to improve the rationality of planning decisions.

The agencies responding to the survey are virtually unanimous in stating that the planning agency responsible for plan proposals should be in charge of the use of models regardless of the origin of these models. In stating this position, the agencies indicate by their comments a concern that unless planning agency personnel are sufficiently well acquainted with the mechanics of the model to operate it, they will not be able to evaluate the output of model runs.

In response to a question on who should be responsible for the development of models the agencies split two to one in preferring that models be developed within the planning agency which will use them, rather than being developed either entirely outside the agency, or through a combination of agency staff and outside expertise. The basis for this view is best expressed by agency comments.

The agency's own research and planning staff should be responsible for the development of all models used because of the uniqueness of each area and requirements of each study. If previously developed or canned programs are used, care should be taken that appropriate features are tailored to the special demands of the study in question.

And, in the words of another agency, "Responsibility for development of models should be fixed as close to the decision-making body (implementing agencies) as is practical, because the model should be designed to solve their problems."

In taking the view that the individual planning agency should be responsible for model development, the agencies appear to be making a distinction between model design (specification of output information, areal detail, decision criteria, model parameters, etc.) and model construction (programming, debugging, testing, etc.). Many of the agencies expressing a preference for in-house model development suggest that the use of outside experts for model construction may be both desirable and necessary depending on agency staff

and budget limitations. In suggesting this however, the agencies often disclosed another major reason for preferring in-house model development. They are concerned that communications between the staff and its expert consultants will not be sufficiently good to permit full understanding of the model by the agency and consequently full utilization of the model by the agency. In the words of one agency:

The agency should be responsible for developing [the model]; however, the actual work may be done by consultants if agency staff are intimately involved with model development. The agency should be able to use, modify, and explain the model after the consultant has gone. Perhaps all that is required is adequate documentation, something that is seldom done. For some purposes canned models would suffice if local staffs could understand them.

In summary, it appears that agencies who have had experience with urban models tend to prefer in-house development of models because of the need for the local agency to define the purpose and operational character of the model so that it will satisfy local needs, because of the uniqueness of each urban area, and because of the difficulty of generating adequate staff understanding of models produced outside the agency. This preference, however, is tempered by the realization that for many agencies in-house development of models is not feasible. In evaluating these responses, it should be realized that many of the agencies expressing the majority view are rather large, well-staffed agencies.

The difficulty most often mentioned by agencies in commenting on problems of integrating the use of models with other planning operations is the inability to schedule agency work well because of the uncertainty of completing developmental work on models. This problem is expressed in a variety of ways. The primary cause of the problem appears to be that many of the agencies have been engaged in original, or developmental work with models. It has been difficult for them to maintain time schedules established for other agency operations because of unexpected delays in making the models operational. Several agencies note that the "model" is on the critical path of the agency's operations so that any delays in model development cause chain reactions throughout the work program.

The second most frequently mentioned problem is communication between the model-builders and other staff personnel. As discussed above, this problem is part of the basis for agency preference for in-house model development. In addition several agencies reported in-house problems of misunderstanding between planner and programmer of the role and purpose of models in the agency's program.

These two problems, scheduling and communications, account for two-thirds of the responses to the question on agency problems. The remain-

ing comments include such concerns as the large amounts of data required by the models, the staff time required to interpret the results of model runs, distortion of work program emphasis due to models, and the comment of two agencies that they had experienced no problems.

In discussing the benefits to their agency of the development and use of models, the clearly dominant benefit experienced was education of the staff. Beyond this, and mentioned much less often were more accurate forecasts and other analyses, and the ability to analyze a number of policy choices. The education benefits expressed are of three types. One is better staff knowledge of the nature of models and of the role of models in planning. A second type is better knowledge about urban areas and about the interaction of components of urban areas. The third education benefit is better understanding of planning through clarification of planning concepts and analysis of planning assumptions in the process of model development.

Several other benefits were mentioned by the agencies. In general these can be grouped under the heading of technical proficiency as they are concerned in one way or another with increased speed and efficiency of planning analysis and forecasting. Several agencies which are working with models have not yet proceeded far enough to evaluate their experience.

It is difficult to generalize the responses of the agencies because there is considerable variety in the shading and nuance of their comments. The flavor of their replies can be gotten from the examples below.

The major benefits appear to have been the educational process concerning good and bad approaches to the model building effort, and the assistance this knowledge will give to later model-building attempts. The model itself appears to have somewhat limited utility.

The major benefit of model usage is the ability to make decisions based on an objective, replicable process instead of a subjective process. Secondary benefits accrue from the professional growth of staff members which normally accompanies their involvement in model development and usage.

The major benefits ought to be the sophisticated manipulation and analysis of large quantities of data, and calculations with rapidity and facility. I am not completely convinced that this is always the case, particularly when total programming time is figured in the efficiency calculation for the total process.

All of the agencies presently using models indicate that they intend to continue using them, and generally plan to modify and refine model techniques over time. Two-thirds of these agencies indicate that they intend to expand their use of models into other areas of planning analysis or forecast.

DATA PROCESSING AND COMPUTER USE IN AGENCY OPERATIONS

The survey results show that most agencies which use computers for models also use them for other agency operations. The extent of such usage appears to be somewhat dependent on whether or not a computer facility is on-site or readily accessible through another public agency. To a larger degree this probably reflects the concomitance of computer-based preparation and analysis of data with the use of models. The existence of a data processing operation within the agency then leads to further use of data processing for other operations.

Most agencies reporting the use of models thus also use data processing for preparation of data (cleaning, sorting, etc.); for maintenance of such basic files as land use inventories, travel data, and population; for tabular reports and statistical analyses of these files; and for preparation of model inputs. Other uses of data processing mentioned by several agencies include: administration (cost accounting, inventory, personnel), work planning (PERT, CPM), and prefield and field control operations for local surveys (sampling, addressing survey forms, data editing and checking).

There is one exception to this general pattern of the use of computer based models coupled with more extensive use of data processing in agency operations. Several of the city planning agencies report the use of data processing for planning operations, principally data file handling and tabular and statistical reports on these files, but no use of models. In these cases, the planning agency has access to a city-operated computer facility. Considerable variation exists among the agencies in the amount of data processing work done by agency staff and the amount contracted to consultants, and in the division of work between in-shop and service bureau computer facilities.

Most of the agencies which reported their computer usage utilize more than one computer system (Table 2). Typically, they use a small computer which is operated by the agency itself or by another public agency, and they rent time on a large computer from a service bureau or other vendor. Twelve of the sixteen agencies reporting equipment usage employ either an agency-operated, or city or state-operated computer facility. Three of the remaining four use service bureaus exclusively, and the fourth uses computer services provided by consultants.

The average usage of computers varies widely among agencies. This variation appears to reflect the stage of the planning process the agency is in at the present time as well as the size of the planning operation. Some agencies report that they anticipate a substantial increase in computer usage in the near future as their programs progress. Others report that current usage is below previous experience.

No agency reported the existence of a fully developed data bank system consisting of both regular data updating procedures and existing programming systems for manipulation and retrieval. However, half of the agencies reported operating systems somewhat short of this ideal. About one-fourth of the agen-

TABLE 2. COMPUTER FACILITIES USED BY PLANNING AGENCIES

AGENCY	COMPUTER	SOURCE	ESTIMATED CURRENT AVERAGE USAGE (hr/week)
Baltimore Regional Planning Council	IBM 1460 & 1620 IBM 7090 & 360/40, UNIVAC 1005	State operated Service bureau	4
Bay Area Transportation Study Commission	Honeywell 120 IBM 7094 CDC 3800	Agency Service bureau Service bureau	50 2-10 1-5
Chicago Area Transportation Study	IBM 1401	Agency	30
Cleveland-Seven County Land Use—Transporta- tion Study	CDC 3200 CDC 360	Agency Service bureau	90 —
Delaware Valley Regional Planning Commission	IBM 360/30 IBM 7094	Agency Service bureau	25 3
Denver Planning Office	IBM 360/30	City operated	less than 1
Eastern Massachusetts Regional Planning Project	IBM 7094 IBM 1401	Service bureau Service bureau	1.2 3 8
Los Angeles City Planning Department	IBM 360/30;/40 IBM 7044; 7094	City operated Service bureau	10
Metropolitan Washington Council of Governments	CDC 3600, GE 235	Service bureau	½-2
New Orleans City Planning Commission	IBM 1401	City operated	4
New York State Depart- ments of Public Works— Subdivision of Trans- portation Planning and Programming	Burroughs B-5500	State operated	60
Puget Sound Regional Transportation Plan- ning Program	IBM 1401 IBM 7094	Service bureau Service bureau	½
Regional Plan Associa- tion of New York	IBM 7094 CDC 3600	Consultant Consultant	— —

TABLE 2. (Continued)

AGENCY	COMPUTER	AGENCY	ESTIMATED CURRENT AVERAGE USAGE (hr/week)
Southwestern Pennsylvania Regional Planning Commission	Honeywell 200	Agency	90-100
Southeastern Wisconsin Regional Planning Commission	IBM 360/30	Agency	25
Tri-State Transportation Commission	IBM 1460 IBM 7094, IBM 360/65	Agency Service bureau	75 —

cies maintain extensive machine-readable data files of such information as land use, population characteristics, travel behavior, and transportation networks. In addition they maintain software packages used for manipulation and retrieval of these files. Only two of these agencies indicated extensive use of general purpose computer program packages for this purpose. By inference, it appears that the others rely primarily on original programming designed for their use. The systems operated by the other fourth of the agencies appear to consist primarily of machine-readable data files which can be readily accessed for special purposes but lack a general purpose manipulation and retrieval capability.

The major problem in data processing reported by the agencies is finding and keeping qualified programmers and other data processing personnel. Almost every agency reported this to be a problem. The staffing problem apparently takes many forms including inadequate salaries for programming staff resulting in high personnel turnover; difficulty of training programmers on-site; management of EDP operations, especially program quality control; and, more basic, finding suitable personnel to fill available positions.

The second most often mentioned problem is the difficulty of communications between the planning staff and the programmers and other EDP personnel. One agency summarized the problem as establishing meaningful communications "between the staff who have a knowledge of machine capabilities and the staff who wish to make use of these machine capabilities." This problem is, of course, related to the programmer personnel problem. The concern for program quality control and dissatisfaction with available programming staff appears, from the statements of several agencies, to result in part from communications difficulty. The program prepared by the programmer often

does not produce the output desired by the planning analyst. Agencies' comments suggest that this is due equally to inability of the planning analyst to describe precisely to the programmer what he wants, and to the inability of the programmer to understand how the substance of the planning analyst's problem may be affected by the choice of data manipulation and computer operations.

It is encouraging to note that in only one instance the planning agency ascribed the planner-programmer communication problem to a negative attitude of the planning staff toward data processing. In general the concern expressed is in terms of an honest misunderstanding between programmer and planner. Few agencies hazarded an opinion on how to deal with this problem other than a general suggestion of improved education on the other's point-of-view for all parties involved. The few who expressed an opinion on a particular strategy for this education agreed that the most promising and efficient approach is to stress education of the planning analyst in the mysteries of computers and programming rather than the reverse. One agency summarized their experience and suggestion this way: "It is easier to train someone familiar with the (planning) application in data processing than it is to train someone familiar with data processing in the application."

A number of other problems were mentioned by the agencies in addition to the major problems of maintaining data processing staff and programmer-planner communication. To a large extent these problems are related to the major problems. For example, concern was expressed for the large amount of time required to get data processing projects operational; for the time involved in debugging programs; for the difficulties of adapting data sources to computer files; for the difficulties of merging data files into a common, consistent framework; and for the general inefficiency of data processing operations. These problems reflect both the personnel limitations and the communications difficulties experienced by the agencies.

This summary of the problems experienced with data processing should clearly be interpreted in light of the current operating experience of these agencies. As discussed above, many of these agencies are actively using computers for a variety of agency operations.

All of the agencies responding to the survey report substantial benefits from their data processing operations. For many of the agencies the discussion of benefits starts from the premise that data processing and the use of computers are essential to their operation. This is true for all agencies involved in the use of models, and particularly true for those agencies responsible for planning and testing transportation systems.

Three kinds of benefits are reported by the agencies. First, and most frequently mentioned, is rapid access to large amounts of data. This includes time saving in data handling, and the benefit of more detailed and more accurate data. Second, several agencies count the ability to solve otherwise intractable problems and do "more sophisticated" work as a major benefit. As

one agency put it, we can "develop answers which no one else can." Third, several agencies attribute both greater planning staff productivity and greater efficiency in using planning staff to the availability of data processing operations.

About half of the agencies reported specific plans for expansion of data processing activities. Mainly these plans entail an expansion of data processing operations to include more data files, and to move toward an integrated information system or data bank. In addition, two agencies intend to add data plotters or other graphic display devices to their computer systems. Several agencies are now in the process of or are contemplating a change in their basic computer equipment. One agency plans a major effort in improving computer utilization.

SUMMARY

We noted at the outset the difficulty and danger of attempting to compare and summarize the reports of agency experience with use of urban development models and data processing. Having ignored reasonable caution already, we will now, with temerity, attempt a brief summary across these two general topics.

The planning agencies appear to be caught between two problems. adequate personnel for computer operations—especially programming—and inadequate communication between planner and programmer. These seem to be disequilibrating problems. The desire of agencies to have model development and use as an in-house operation to alleviate the communications problem runs head-on into the personnel problem. Solving the personnel problem by use of outside expertise appears to aggravate the communications problem, particularly for continuing use of models.

Despite these problems, it is clear from agency experience and future plans that the use of models and data processing has been highly beneficial and often essential. Although the problems are difficult they are being overcome.

Some other characteristics of agency experience seem quite important to future development in this area. It appears that there is relatively little communication between agencies on either models or data processing systems. As was noted earlier the real or apparent uniqueness of each urban area and each planning program leads to some sentiment for particularized models. However, as indicated in Appendix A, there is some current use of the same model in several agencies. Similarly, there seems to be a heavy dependence on original programming for data manipulation and retrieval, file maintenance, data analysis, etc. There is little evidence of communication between agencies on software systems for these purposes, and little evidence of the use of existing, general purpose software systems. Again the uniqueness of the planning programs, the data sources, the coding systems, etc., explain, at least in part, why this is so.

In view of these problems and in view of planning agency determination to

continue and expand these activities, it appears that two "services" to the planning agencies would be highly beneficial at this point. One, obviously, would be extensive documentation of existing models, a careful evaluation of these models, and an effort to generalize them for easy use by many agencies. Second, and equally obvious, is the desirability of a serious effort to evaluate, develop, and make generally available programming systems specifically designed for planning analysis and manipulation of the kind of data files used by planning agencies.

Neither the documentation of these problems, nor these suggestions are original. The survey results simply reinforce the concerns already expressed by people active in this area. The arguments against these suggestions—the rapidly changing needs and possibilities in the field, the need for additional research to validate model assumptions, and the primitive state of exploration of modeling techniques in planning—are well known. But, it is equally clear that considerable resources will be committed to model development and use of data processing in the future; and it appears that considerable economies, improved efficiency, and higher quality could be achieved through some stock-taking and greater coordination.