WHAT WE NEED TO KNOW ABOUT URBAN INFORMATION SYSTEMS -- AND WHY

Stephen Gale, University of Pennsylvania

One of the most serious problems with current perspectives on the use of analytical methods in the examination of social problems in urban areas has been the failure to appreciate the relationships between the questions asked and the kinds of information needed to answer them.[1] The multitude of divisions in social science theory and practice notwithstanding, two positions have emerged: theories have either been developed with idealized information bases in mind or been constructed to account for existing data. Rarely is any consideration given to the information requirements for answering specific classes of questions; even rarer is there a recognition of the need to develop theories of information collecting and organization in terms of the needs of inter-related problem areas.[2] The structure of urban data systems has, in effect, been treated as an almost exogenous condition in the development of social theories and methodologies.

While it is apparent that theories of urban structure and change (and the associated planning and policy decisions as well) should reflect a detailed understanding of the social and economic processes operating within our cities, contemporary analyses have unfortunately been restricted by the nature of existing types of information systems.[3] In the United States, for example, empirically-oriented urban theories and models have been developed largely in terms of the coarse spatial and temporal structure of the federal decennial census and other cross-sectional descriptions of state characteristics, rather than in terms of descriptions of activities and processes. Even when survey data are available, they are usually simply more detailed cross-sectional accounts which make little effort toward adequately capturing the incremental nature of changes in urban areas. The use of such information systems effectively restricts the range of questions and theories to those appropriate to the depiction of state descriptions and equilibria conditions (Machlup, 1963: 9-42); theories of social change are usually precluded and planning and policy decisions are forced into ad hoc environments.

Although there have recently been several moves in the United States toward investigating sources of data on urban social and environmental characteristics and their potential utility in the development of comprehensive urban information systems (e.g., American Society of Planning Officials, 1967; Dunn, 1965; Hirsch and Sonenblum, 1970; Kaysen, 1969; Kraemer, 1969, 1971; and Westin and Baker, 1972), paradoxically very little attention has been given to investigating the relationships among information systems, social theories, and the kinds of pragmatic situations in which they are used.[4] In part, this state of affairs is the result of the complexity of the problem: information systems cannot, in principle, be given universal specification, nor can the needs of the variety of possible users be known or taken into account. Equally important, however, is the fragmented manner in which the problems concerning the organization of information systems have been handled: for example, administrative, planning, social science, and other needs are often analyzed in entirely different ways. Thus, there are strong reasons to begin reformulating and revitalizing our approaches to social science data collection and use. But any new approach must be grounded on (i) a careful investigation of data needs in specific theoretical and pragmatic contexts, (ii) an understanding of the kinds of benefits and disbenefits which can be expected to accrue with the use of alternative types of information systems, and (iii) an appreciation of the associated political and legal consequences of various data collection and utilization programs. The former issue may be regarded as a problem involving the development of empirically grounded, instrumental social theories and models; the latter two are concerned with the evaluation of effects of the implementation of urban information systems.

To provide a substantive basis for the exploration of these ideas, it is necessary to examine the problems of information systems design, model and theory development, and implementation within a specific empirical context. In effect, a pilot study is needed which permits an assessment to be made of the uses and effects of different types of information systems. Unfortunately, a broad-based study of this type would require a form of social experimentation which is both expensive and politically prohibitive. A more limited investigation has now become feasible, however. In 1971, Wichita- Sedgwick County (Kansas) began taking a detailed, annual enumeration of the population and dwelling-units for the entire metropolitan area. By using these data as the empirical base for the development of longitudinally-structured files, a detailed examination of the effects of developing and using such an urban information system can be undertaken.[5] The intent of this essay is to outline the motivation for the experiment and trace the steps to be taken. Note, however, that the purpose of the experiment is to evaluate the practical design, implementation and utilization features of the information system; as such, it should be viewed as the basis for 'models of data' (in the sense of Moore and Gale, 1973), rather than as a comprehensive system for use with the kinds of theories which have developed in other contexts.

The discussion will be presented in four parts. Section 1 will outline some of the background considerations in the design of urban information systems. A summary of the main points of the experiment in the design of such a system will be given in Section 2. Section 3 will offer some conjectures about the policy implications and potential institutional impacts of changes in the design and use of different urban information systems. Finally, Section 4 will present the conclusions of the argument. The idea here is thus to provide a systematic explication of the kinds of considerations which bear on the devel-

opment and utilization of such information systems.

1. Information Systems and Social Theories

The development of various urban data systems over the past decade typifies the response of a technological society to the range and complexity of public issues and problems which it faces. It is a recognition not only of the need for effective information processing for public decision-making, but of the failure of politically-based methods. Unfortunately, in the spirit of technological optimism, the design of current information systems has primarily emphasized existing data collection programs, technologies, and approaches to decision-making. And although there has been general criticism of such approaches to urban decision-making,[6] the diversity of these comments has made it difficult to identify the grounds for making positive substantive changes. There are users of information systems who want to promote specific requirements; there are visionaries who foresee a system of social accounts and indicators which parallel national and regional economic accounts and indicators; and there are professional statisticians who are concerned primarily with obtaining adequate data for use within the framework of existing theories and methodologies. In the midst of this heterodoxy, however, is a kind of methodological orthodoxy. Consider, for example, the argument by Hirsch and Sonenblum (1970: 1):

> ...the information environment is being improved through three related developments: first, modern technology makes it possible to collect, organize, store, and retrieve vast quantities of basic data which can be further processed through a data bank framework. Second, analytic models are being refined and improved making it possible to be more specific in the identification of relevant information for decision purposes. Third, decision making institutions themselves are being improved to more rationally apply relevant information to specific problems and to more quickly adapt to, and anticipate, changing circumstances that may affect the problems under consideration.

An orthodoxy thus appears as faith in soundness of the design of contemporary methodologies and a general optimism with regard to the adaptability of existing technology.

The issue is not quite this simple, however. While recent advances in the organization of data banks and high speed information processors provides a recognizable foundation for such technological optimism, at the same time there has been little in the way of a serious examination of the kinds of data and information systems which are needed for examining specific classes of questions. Problems in the design of urban information systems have thus been generally equated with hardware and software development, the reorganization of existing data, and the use of technocratically based decision-making institutions;[7] scant attention has been paid to the problem of designing information systems which are appropriate for examining social processes and decision-making procedures at the urban scale. As Dunn (1974: 22) has pointed out:

> It should now be clear that a theory problem lies behind the design problem. This obtains at two levels. When we speak of "existing and potential information processors," we are making an implied reference to our theories and models of social science and social organization. The symbolic representation of those theories and models governs the way we designate symbolic data elements. At some point we must concern ourselves with a comparative analysis of the structure and symbolic data requirements of the various theories of social science and operating models of social organization.

On this view, the design of urban information systems is thus more a problem of technological adaptation; it also requires a restructuring of our view of social modelling and practice in order to account for the on-going relationships among social theories, information, and information processors.

Paralleling the kind of criticism Dunn offers on the 'data integration cum information retrieval' approach to the design of urban information systems, is another, more substantively-based, discussion of the aims of the character social indicators. For example, Sheldon and Freeman (1970: 103) have argued that

> ...a viable alternative is to redirect and rechannel existing efforts, to reformulate the goals of the social indicator movement, to modulate the promises on the utility of indicators in ways that make them realistic, and to exploit the momentum gained from the movement to improve the quantity and quality of data on the structural outlines and social processes of society. There are extensive needs and attractive possibilities of three types that can be promoted. The social indicator movement can contribute (1) to improved descriptive reporting; (2) to the analysis of social change; and (3) to the prediction of future social events and life.

The point made here also emphasizes the strong dependencies between theories of social processes and the design of information systems; in effect, the contention is that viable theories of urban social processes must refer both to the kinds of concepts and entities that should be observed and the kinds of information which can be effectively collected and processed.

Going hand-in-hand, therefore, are the joint problems of social theory formulation and information system design. Neither can theories be developed without reference to the kinds of data which are required to represent and evaluate them, nor does information come in a theory-

free state.[8] Theories, as potential answers to questions, are designed with particular data structures in mind; and information is collected, measured and organized in terms of (even general) conceptions of what sorts of questions they will help to answer.[9] Moreover, the types of intended prescriptions and the existing structure of the social decision-making institutions are both integral elements in this combined theory formulation/systems design process: social theories which are instrumentally and prescriptively oriented presuppose an information system which monitors control variables; and the control variables must, in turn, be viewed as such by the institutions which formulate and carry out social policies.

The problem of designing information systems for urban areas is thus anything but a problem of simply reorganizing existing data bases into computer readable files and adapting existing software to retrieve bits of data -- though these are obviously important issues. It is an inclusive problem requiring attention not only to the development of new classes of social theories and data collection and organization procedures, but also to the design characteristics of the social institutions which are responsible for implementing and utilizing such systems. As was noted above, owing to both financial and political limitations, this very general form of social experimentation cannot be adequately fashioned at the present time. Rather, a more circumspect approach is required which examines the design of urban information systems in terms of incremental changes: that is, given the existing institutional climate and the associated restrictions on data collection and analysis procedures, we should be able to investigate the interactions between the development of new classes of social theories and the kinds of data which are required to support each -- and then make some assessment of the benefits which accrue to changes in information systems design. This will, in fact, be the strategy taken in the experiment to be outlined in Section 2.5.

The discussion thus far has addressed one primary theme: it has been argued that current social theories largely presuppose cross-sectional descriptions and therefore tend to ignore the more general problem of inquiry wherein theories and information systems are jointly designed; or as Maslow (1966) puts it, where the only tool available is a hammer, there is a tendency to treat everything as if it were a nail. A second theme concerns the relationships between questions and the information used in their analysis; this point is of especial importance in the design of social information systems and thus, before outlining the experiment in the following section, a sketch of this relationship will be presented.

Several recent essays which have presented a perspective on social science inquiry in terms of question-answering systems have maintained the position that different classes of questions, and therefore potential answers (i.e., theories), presuppose different types of information and information organization (cf. Dunn, 1974; Gale, 1974, 1975; and Gale and Horn, 1975). Owing to variations in the kinds of substantive information associated with each type of theory, the issue is unfortunately far from clear at this point. Dunn (1974: 69-93), however, has presented a quite reasonable 'first-approximation' which captures at least part of the issue. As he sees it, there are four basic types of representations of information:[10]

(i) State descriptions. Representations of this type depict the status, the results of the performance, of systems and include five structural characteristics: "the name of the entity being represented, a time descriptor that specifies the time of the observation, a space or place descriptor, a descriptor that names the attribute under observation, and a quantifier or quality description that specifies the unit of measurement, count, or attribute quality." (Dunn, 1974: 78). Such representations give cross-sectional descriptions of the traits that an entity possesses, the extent to which it is possessed, and where and what time the observation is made; in general, no indication is provided concerning the time-dependent changes that give rise to the specific observations, nor is there a self-conscious characterization of either the observational procedure or the model of measurement, classification, and definition (Moore and Gale, 1973). Furthermore, only under conditions where the general structure of the processes is known and are stationary can inferences be made concerning the process of change. An example of this type of information system is the decennial census' depiction of population size by census tract or block.

(ii) Activity descriptions. Representations of this type depict state conditions as well as the kinds of performance (or activities or developmental sequences) that give rise to them. To the five structural characteristics of state descriptions are thus added: "a description of the nature of the act, the description of the relevant pre-act and post-act states of the entity, and the specification of the time span or duration of the act" (Dunn, 1974: 82). Such a representation is thus a description of the state of a system and the observed processes of change (Gale and Horn, 1975); note, however, that the use of the term 'process' here does not imply information on the properties of the institutions which structure the performance patterns. Extending the example given above, an information system of this type would be structured as a longitudinal record of the sequences of births, deaths and moves of each individual in the population.

(iii) Developmental descriptions. Representations of this type depict, together with the associated state, activity, and programmatic descriptions, the alternative goals (paths) which any set of programs can entertain. Programs, though fixed for any sequence of past observations, can also be treated in a developmental context; new rules and norms, related to alternative system goals, can be formulated as part of a representation of social processes and, as such, can thus be directly included as an element of the information system. The last extension of the example would thus include a longitudinal record of population changes, a description of the

relevant social institutions, and a characterization of alternative system goals and their associated norms and rules.

All of this is admittedly abstract. At the core, however, is a concept of a hierarchy of social information which is linked to specific classes of questions and social theories. For example, where a question refers to the size of the population in small districts in the United States in 1970, state descriptions derived from the decennial census can provide a sufficient information base. But where questions refer to the processes which gave rise to these observations, then a higher level of information is required -- the specific level again depending on the kind of question which is asked. What is important to keep in mind is simply that the design and development of an urban information system depends on more than the availability of observations; the representations included in the system imply the classes of inferences that can be made and, therefore, constitute an integral part of any theory about the social system.

As has been noted, though the inclusive goals of experimentation with urban information systems cannot be realized at the present time, it is possible to examine one aspect of the issue in some detail. More specifically, the experiment which shall be described provides a means for evaluating the effects of an information systems design based on activity descriptions in terms of one problem area: the examination of the related changes in population and dwelling-unit characteristics within cities and their associated effects on the provision of social services. The idea will be to integrate some relatively recent theoretical advances in this area within a theory of information systems requirements to provide a basis for a detailed case study.

Although little in the way of empirical analysis in this area is currently available, an increasing number of social scientists and policy makers are adopting the position that adequate decisions about housing and social service provision in urban areas can only be achieved when social and economic theories are based on disaggregated, longitudinal information (i.e., micro-analytic activity descriptions).[11] However, while the most technically sophisticated models for individual urban areas are micro-analytic in structure (e.g., those developed by the National Bureau of Economic Research (Ingram, Kain, and Ginn, 1972)), research on the design of information systems which would be supportive of such modelling efforts are meager. The position taken here is that if we wish to further develop and integrate this type of understanding of social processes with the concerns of those who are concerning with making planning and policy decisions, then the need for more careful scrutiny of information systems which provide for detailed and frequent monitoring of change (for the provision of activity descriptions) is paramount.

In this regard, it is important to put existing information resources into perspective. Data from the federal decennial census, which are often regarded as the primary (and sometimes the only) important public source of social science data in the United States, provide basic enumeration data at ten year intervals (though often with three to five years delay) for selected spatial aggregates (e.g., counties, census tracts and census blocks); in terms of Dunn's classification, they are state descriptions. For many kinds of localized (e.g., urban) analysis and monitoring programs, however, these data constitute an out-of-date, spatially coarse information base. To overcome these deficiencies, the Bureau of the Census, local governments, private industry, and a variety of national funding agencies have sponsored a multitude of surveys as well as data integration and data-bank plans to provide more detailed, contemporary data to urban researchers and planners. Most of the surveys have, however, been one-shot samplings which employ the decennial census as a sampling frame; the development of data-banks, on the other hand, have primarily utilized existing administrative and statistical records. Even where there have been attempts to advance the use of panel studies (e.g., Morrison, 1969; Birch, 1974), the information base often suffers both from the lack of spatial detail at any one point in time and, more generally, from the difficulties in constructing longitudinal indicators for variable areal units and population sub-groups. There is a distinct need, therefore, to develop procedures for monitoring the patterns of socio-economic and demographic changes in specific urban areas. Equally important is the need for a parallel development in social theory which gives rise to dynamic indicators which depict differential rates of change.

At the present time, the type of information system required for such a study is not generally available in the United States (the main developments have occurred in European countries). Recently, however, the Wichita-Sedgwick County (Kansas) Metropolitan Area Planning Department (MAPD) has responded to the need for more detailed up-to-date information on the structure of local urban processes by instituting an annual population and housing Enumeration in 1971.[12] Under mandatory Kansas law, the county assessor enumerates the population in each non-census year, specifying the name and legal age of each resident of the county. The Wichita-Sedgwick County MAPD, in cooperation with several other local agencies, has taken advantage of this situation by adding a number of questions to the survey schedule. Though the original intent was simply to provide current information to planners and administrators, it became apparent that the Enumeration could also provide the basis for the development of an urban information system which would contain activity data on population and housing characteristics for an entire urban area in the United States.[13] Using the Wichita-Sedgwick County Enumeration as the foundation for a pilot urban information system, the experiment can thus investigate: (i) the use of the Enumeration in the development of disaggregated longitudinal data files of urban populations and housing conditions; (ii) the construction and evaluation of models of small area change based on micro-level activity descriptions (or processes); and (iii) an assessment of the kind of political and legal costs which are likely to result from the development,

implementation, and utilization of information systems.

2. Outline of an Experiment in the Design of Urban Information Systems

The experiment to be outlined here is motivated by three related concerns: (a) the need for an assessment of the kinds of urban information systems which are appropriate for dealing with the analysis and evaluation of contemporary problems of American cities; (b) the need for development of theories and indicators for describing, explaining, and predicting changing conditions within urban areas; and (c) the need for practical, experience-based guidelines for designing and implementing such information systems. The information system based on the Wichita-Sedgwick County MAPD Enumeration and the potential for developing a co-ordinated approach to urban information system design provides the empirical motivation for the study. It is designed as a three stage investigation of the means for developing, implementing and utilizing detailed longitudinal municipal information systems, and an assessment of the kinds of costs and benefits accruing to such systems. These stages embrace the following objectives:

- Stage I: The development of data collection, organization and retrieval procedures for longitudinal files
- Stage II: The development of classes of social indicators relevant to describing and explaining the related processes of change in population and housing characteristics and the provision of services within urban areas.
- Stage III: The evaluation of alternative methods of developing dynamic indicators (say, using the decennial census), their relative financial costs, and associated legal and political issues.

A schematic representation of the stages of the experiment are given in Table 1. A brief outline of each stage is given below.

2.1 STAGE 1: DATA BASE DEVELOPMENT

The first stage of the experiment is a two part examination of (2.1.1) the methods currently employed in Wichita for collecting their annual enumeration and (2.1.2) the methods for developing, maintaining, and accessing these records as a longitudinal information system.

2.1.1 Review of the existing methods of data collection

The first step constitutes an examination of the methods which have been used in collecting the special yearly Enumeration in Wichita (including the 'out-of-pocket' and indirect costs of existing methods of data collection and coding).

2.1.2 Development and refinement of data integration and handling methods

There are six principal areas of interest here:

(i) An evaluation of 'non-response' in the existing data file and methods for assigning values where information is missing (e.g., Goldstein, 1975; Goldstein and Gale, 1975).

(ii) The provision and comparison of alternative geocoding schemes.

(iii) The provision of a procedure for integrating the longitudinal records with other available information (e.g., the existing real estate records for Wichita).

(iv) To further refine existing methods for creating and maintaining longitudinal data files based on the Enumeration (cf. Gschwind, 1975).

(v) To develop appropriate software packages for data management and retrieval.

(vi) To develop methods for using longitudinal records for sampling frames for extended attitudinal surveys aimed at in-depth analysis and evaluation of specific indicators.

2.2 STAGE II: ANALYSIS

In the second stage, the Wichita information system forms the basis for (2.2.1) developing theoretically-based indicators which describe both the current status and changes in population and housing characteristics and assessing the effects of alternative aggregation procedures, and (2.2.2) providing ways for interpreting the indicators in terms of policies relating to urban housing and local service provision. Note that the Enumeration has made this sort of analysis feasible since:

(a) the Enumeration monitors a wide range of population and housing characteristics for the whole population;

(b) in longitudinal form, the Enumeration permits the continuing identification of the activities of those dwellings and households which enter the mobility process each year; and

(c) The Enumeration provides the basis for cross-classification models of households and occupancy units, yet retains the identification of individuals from the various classes for reaggregation and more detailed survey analyses.

2.2.1 Models and Parameter Estimates

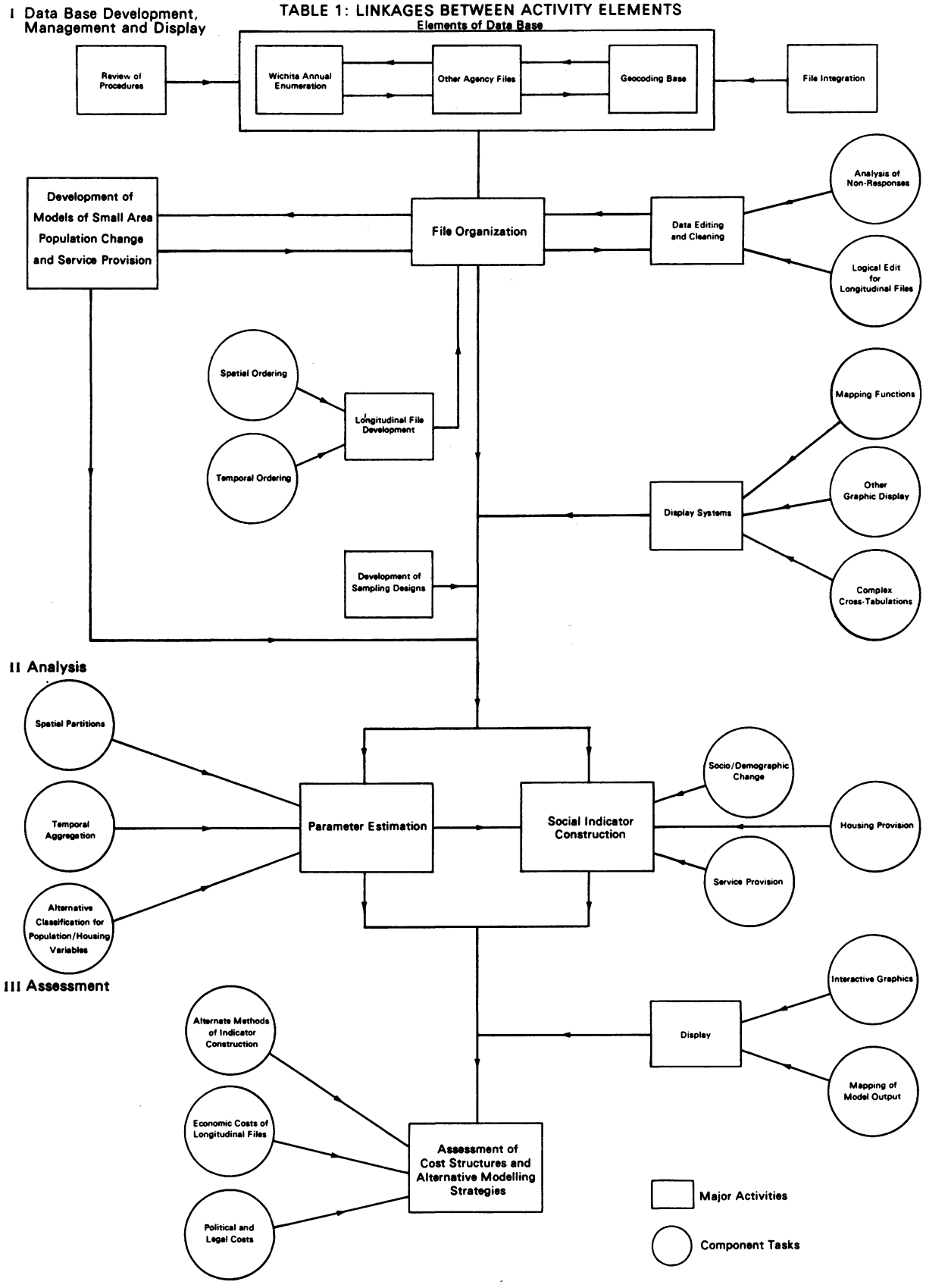
Using this information system, the purpose of the first part of Stage II is thus to identify and estimate indicators of the present demographic and economic status of the population and of its mechanisms of change (activities). Here, the experiment has two principal aims:

(i) to refine existing micro-analytic models of the longitudinal structure of population characteristics (e.g., Moore, 1975; Moore and Gale, 1973); and

(ii) to investigate alternative methods for estimating the parameters of these models, i.e., under alternative classification schemes and/or statistical methods.

The models which will be used to describe patterns of change in populations and housing characteristics are generalizations of the kinds of discrete space stochastic process models used to

TABLE 1: LINKAGES BETWEEN ACTIVITY ELEMENTS



describe social and geographic mobility.[14]

2.2.2 Special Properties of Indicators

Given the indicators of residential mobility, the second part of Stage II will investigate their value in such problem areas as:[15]

(a) projections of population and housing for small areas which explicitly include inter- and intra-urban mobility processes;
(b) the description and evaluation of the impacts of major public and private decisions (such as changes due to urban renewal projects or the construction of a new expressway) on existing patterns of population relocation; and
(c) evaluating the impacts of alternative patterns of mobility for the character of local areas and the kinds of housing facilities that can be provided.

2.3 STAGE III: ASSESSMENT

The third stage of the experiment is concerned with (a) an assessment of the utility of micro-analytic information systems (in terms of economic, political, and legal costs) relative to a parallel system based on the use of data from the decennial census; and (b) the potential for utilizing any positive results in redesigning urban information systems in other areas. Thus, as Dunn (1974) has pointed out, the issue is not merely one of trying to make the best of existing data files as is so often the strategy (e.g., Flax and Taylor, 1973), but of identifying the necessary administrative and legal adjustments to obtain information consistent with the needs of social theory and policy developments.

The object of the experiment is thus quite straightforward: the idea is to provide an initial determination of the kinds and levels of benefits which are gained from the use of urban information systems which include activity as well as state descriptions. Though the experiment is limited to only one area (i.e., Wichita) and one type of activity (i.e., residential mobility and occupancy change), it should nevertheless offer a preliminary indication of the effects of utilizing advanced types of information systems. Most importantly, however, it will provide a case study of a procedure for designing information systems which is based on the joint determination of social theories and the associated data resources.

3. Social Institutions and Urban Information Systems

On the surface of things, there are some obvious reasons to be concerned with the development and utilization of richer data bases for urban research: theories will be better grounded, projections of contingent changes will be more accurate, and so on. But all of these are practical issues which can be mediated, at least in part, by cost factors and the relative effectiveness of other procedures for gaining the same insights. Rather, any long-run evaluation of new types of urban information systems must depend both on the cost effectiveness of the results and an external justification of the kinds of changes in social institutions that are likely to be brought about. As has been noted above (particularly in connection with Dunn's concept of 'developmental descriptions'), the range of these impacts is undoubtedly quite broad and difficult to identify without some specification of societal goals. Nevertheless, one fairly general observation can be made.

Perhaps the most significant area of dispute between those who are involved in the technical aspects of the development and design of urban information systems and the users of such systems is the failure by the former groups to take cognizance of the nature of urban institutions. To argue simply on the grounds that hardware and software are available for advanced system design is an insufficient basis for policy change. Nor is it feasible to maintain, as does Downs (1967), that the primary consideration is the final payoff of the system; it is simply too difficult to evaluate all of the long-run consequences of each design principle. Information systems must instead be designed in terms of the kinds of data which are (or can be made) available, the type of decision-making environment desired (e.g., decentralized-political, centralized-administrative), and ethical considerations (such as the right to personal privacy). In this sense, the development of such systems can be treated as any other major technological innovation which involves both technical and social considerations.

Unlike many other kinds of technological changes, however, the development and use of urban information systems not only has direct and immediate effects on the structure of social institutions; it also serves as an instrument for bringing about changes in these same institutions. Hardware and software purchases, data collection and processing, and so on, all depend on the existence of specific kinds of social institutions for their development and implementation; and, more to the point, decisions that are made on these issues can act as agents for related institutional changes. Institutional systems, in this respect, are as much the products of societal decision-making processes as they are the instruments which bring them about.

This point can be illustrated with reference to Braybrooke and Lindblom's (1963) well-known discussion of societal decisions. In their model, decision-making is pictured as being governed by the extent of information available and the degree of change desired. For example, what they term "administrative and 'technical' decision-making" (Braybrooke and Lindblom, 1963: 78) occurs where incremental changes are predicated on a high degree of understanding. Politics, on the other hand, is concerned with incremental changes based on what they call "low understanding." However, as we have seen, changes in the structure of information systems are not simply the result of exogenous inputs to the decision-making process; they are part of a process in which information is collected and structured to meet the need of answering specific classes of questions. Conscious or not, moves toward information systems which permit what Braybrooke and Lindblom regard as a high degree of understanding, thus brings about concomitant changes in the process of decision-making: for example, the development

of integrated, detailed records of urban populations and their respective environments might be expected to lead to a shift away from decentralized political decision-making and toward more centralized administrative procedures. In short, the development of urban information systems is not simply a technical scheme for adding data; it is also a commitment to changes in the kinds of urban decision-making institutions. It should be kept in mind, of course, that there is as yet little empirical evidence on the institutional effects of changes in urban information systems or on how alternative strategies for implementing them affects the rate at which such changes take place.

4. Conclusions

In this essay, it has been suggested that urban information systems may be viewed as parts of a general program of inquiry, i.e., as components in a question-answering process which is addressed to problems of urban processes and programs. The elements of such an information system are not observations, per se, but observations conditioned by specific social theories and theories of data collection and organization. The utility of information systems was, moreover, presented as being dependent on both technical design issues and the identification of the appropriate institutional contexts of use: that is, the closure conditions (e.g., with respect to the spatial coverage of the system) and the types of societal decision-making procedures employed.

As yet, there has been very little by way of empirical investigations of alternative information systems in a variety of urban contexts. Data bases are usually limited to those currently available from the federal census or local administrative sources; the designers of systems have taken their guidelines primarily from the existing software requirements rather than from the substantive nature of the questions asked; institutions have been regarded as fixed rather than as design components. What is required, it has been argued, is a comprehensive set of experiments with a variety of urban information systems (or perhaps with one which can provide a basis for several different designs) and an evaluation of both technical and institutional design criteria.

The experiment which was outlined here is conceived of as an initial study of several aspects of the more general problem of the design of urban information systems. Utilizing the one source of detailed activity data for an entire American city, the experiment seeks to assess the utility of such an information system in terms of its ability to (i) provide descriptive and prescriptive indicators of the structure and patterns of residential mobility and occupancy change and their implications for provision of and accessibility to public services, (ii) provide evidence of the relative sensitivity of these indicators to context-dependent instrumental changes, (iii) identify the relevant data requirements for such monitoring programs, and (iv) clarify the kinds of political and legal (i.e., institutional) effects that are associated with the development and use of such systems. Though the experiment concentrates only on indicators relating to residential mobility, occupancy patterns and public service provision, the thrust of the argument is much broader: using this approach as a paradigm for the investigation of the design conditions for urban information systems, a parallel can be drawn to the use of similar data for monitoring other urban processes such as land-use change, labor force participation and transportation system development. The strength of the approach thus lies in the strategy of focussing attention on the linkages among data systems design, theory formulation, construction of indicators, and system implementation. It is only as these foundational issues are clarified that we can move confidently to the stage of designing comprehensive urban information systems which both monitor the progress of existing social programs and provide effective decision-making institutions.

Footnotes

*The support of the National Science Foundation, Grant No. GS-39837, and the National Institute of Mental Health, Center for Studies of Metropolitan Problems, Grant No. MH-25096, is gratefully acknowledged as are the many important contributions and comments of Eric G. Moore.

1. See Berger and Gale (1975), Dunn (1974), and Gale (1974, 1975) for further discussions of this issue.
2. With respect to the obvious exception, survey design and implementation, the focus is primarily on problems of (i) eliciting true responses to specific questions and (ii) sampling, rather than on the problem of developing and organizing generalized information systems.
3. See Leontief (1971) for a very effective discussion of this issue.
4. See Dunn (1974) for a recent analysis of this issue.
5. Other cities are beginning to show interest in developing more sophisticated data bases, but the range of data collected is still quite restricted compared with the variety of dwelling and population variables available in Wichita. See, for example, Rosemeyer's (1975) discussion of the Cincinnati system.
6. Cf. Campbell (1970), Downs (1967), Dunn (1974), Hanson (1971), Sheldon and Freeman (1970).
7. Consider as an example the cities in the USAC program which built data-banks based on the integration of existing administrative files (Kraemer, 1971). Notably, the emphasis in this program was on computer methods for file integration and data retrieval and display. The volume edited by Bisco (1970) and Westin and Baker's (1972) Databanks in a Free Society are good illustrations of this approach.
8. A similar point is often made with respect to the so-called 'radical conception of meaning variance:' that is, what is perceived (observed) depends on what is believed (theorized). For discussions of this issue, see Feyerabend (1965, 1970), Hanson (1958), Kuhn (1962), and Toulmin (1972).
9. See Dunn (1974: 88-89) for a related dis-

cussion.

10. Note that particularly with respect to (iii) and (iv), Dunn's formulation is given substantial reinterpretation. Hopefully, however, this will not result in any misinterpretations.

11. See, for example, Dunn, 1974; Gale, 1973; Maddok, 1963; Moore and Gale, 1973; Orcutt, 1970; Revelle, 1968; Riley, Foner, and Johnson, 1972; Taeuber, 1968; and Willis, 1974.

12. See Gschwind (1973) for a discussion of the structure and development of the enumeration.

13. It is important to note that, although the experiment described here will deal with the evaluation of the existing information system for Wichita, Kansas, the overall intention is to identify the classes of advantages and disadvantages which accrue as a result of using similar information frames in other areas and for a wide range of substantive issues. In this context it is important to show that the institutions which have been used for the justification of data collection and utilization in Wichita are not peculiar to that area (or at least are not precluded in other areas).

14. See Gale (1972, 1973), Ginsberg (1972), and Moore and Gale (1973).

15. See Moore (1975) for a review of the existing work on these issues.

References

American Society of Planning Officials (1965). Proceedings of the Third Annual Conference on Urban Planning Information Systems and Programs, 1965. Chicago: ASPC.

Berger, R. and S. Gale (1975). "Notes on Information Systems in Urban and Regional Decision-Making." Research on Metropolitan Change and Conflict Resolution, Working Paper No. 16, Peace Science Department, University of Pennsylvania, Philadelphia.

Birch, D.L. (1974). Patterns of Urban Change. Lexington: D.C. Heath (Lexington).

Bisco, R.L., ed. (1970). Data Bases, Computers, and the Social Sciences. New York: John Wiley.

Braybrooke, D. and C.E. Lindblom (1963). The Strategy of Decision. Glencoe: The Free Press.

Campbell, A. (1970). "Some Questions about the New Jerusalem." In R.L. Bisco (ed.), Data Bases, Computers and the Social Sciences. New York: John Wiley.

Downs, A. (1967). "A Realistic Look at the Final Payoffs from Urban Data Systems." Public Administration Review 27, 3.

Dunn, E.S., Jr. (1965). Review of Proposals for a National Data Center. Statistical Evaluation Report No. 6, Office of Statistical Standards, Bureau of the Budget, Executive Office of the President.

Dunn, E.S., Jr. (1974). Information Processing and Statistical Systems-Change and Reform. New York: John Wiley.

Feyerabend, P. (1965). "Problems of Empiricism." In R.G. Colodny (ed.), Beyond the Edge of Certainty. Englewood Cliffs: Prentice-Hall.

Feyerabend, P. (1970). "Problems of Empiricism: Part II." In R.G. Colodny (ed.), The Nature and Function of Scientific Theories. Pittsburgh: University of Pittsburgh Press.

Flax, M.J. and J.B. Taylor (1973). "Urban Indicators as an Aid to Understanding and Decision-Making." Proceedings of the Urban and Regional Information Systems Association, 393-420.

Gale, S. (1972). "Stochastic Stationarity and the Analysis of Geographic Mobility." In W.P. Adams and F.M. Hellener (eds.), International Geography 1972, University of Toronto Press.

Gale, S. (1973). "Explanation Theory and Models of Migration." Economic Geography 49, 257-274.

Gale, S. (1974). "A Prolegomenon to an Interrogative Theory of Scientific Inquiry." Research on Metropolitan Change and Conflict Resolution, Working Paper No. 9, Peace Science Department, University of Pennsylvania, Philadelphia.

Gale, S. (1975). "On a Metatheory of Planning Theory." Research on Metropolitan Change and Conflict Resolution, Working Paper No. 15, Peace Science Department, University of Pennsylvania, Philadelphia.

Gale, S. and E. Horn (1975). "Notes on the Use of Longitudinal Data in Urban Research." Research on Metropolitan Change and Conflict Resolution, Working Paper No. 13, Peace Science Department, University of Pennsylvania, Philadelphia.

Goldstein, H.A. (1975). "Some Problems In and Approaches Toward Handling Missing Data in Longitudinal Files." Paper presented at the annual meetings of the American Statistical Association, Atlanta, Georgia.

Goldstein, H.A. and S. Gale (1975). "Some Problems In and Approaches Toward Editing and Maintaining Longitudinal Data Files." Research on Metropolitan Change and Conflict Resolution, Technical Paper No. 5, Peace Science Department, University of Pennsylvania, Philadelphia

Gschwind, R.A. (1973). "The Intergovernmental Enumeration, Wichita-Sedgwick County, Kansas, 1971-1973." Research on Metropolitan Change and Conflict Resolution, Working Paper No. 2, Peace Science Department, University of Pennsylvania, Philadelphia.

Gschwind, R.A. (1975). "Creation of Longitudinal Files from Annual Enumerations in Wichita-Sedgwick County, Kansas: Comments and a Case Study." Mimeo, Peace Science Department, University of Pennsylvania, Philadelphia.

Hansen, M.H. (1971). "The Role and Feasibility of a National Data Bank Based Upon Matched Records and Alternatives." Federal Statistics: Report of the President's Commission, Vol. II, Washington, D.C.

Hanson, N.R. (1958). Patterns of Discovery. Cambridge: Cambridge University Press.

Hirsch, W.Z. and S. Sonenblum (1970). Selecting Regional Information for Government Planning and Decision-Making. New York: Praeger Publishers.

Ingram, G.K., J.F. Kain and J. Royce Ginn (1972). The Detroit Prototype of the NBER Urban Simulation Model, National Bureau of Economic Research, New York.

Kaysen, C. (1969). "Report to the Task Force on the Storage and Access to Government Statis-

tics." The American Statistician 23, 3.
Kraemer, K.L. (1969). "The Evolution of Information Systems for Urban Administration." Public Administration Review 29, 389-402.
Kraemer, K.L. (1971). "USAC: An Evolving Governmental Mechanism for Urban Information Systems Development." Public Administration Review 31, 543-551.
Kuhn, T.S. (1962). The Structure of Scientific Revolutions. Chicago: University of Chicago Press.
Leontief, W. (1971). "Theoretical Assumptions and Non-observed Facts," American Economic Review 61, 1-8.
Machlup, F. (1963). Essays in Economic Semantics. (Editted by M.H. Miller.) New York: W.W. Norton & Co.
Maddok, G. (1963). "A Longitudinal Multi-Disciplinary Study of Human Aging, Selected Methodological Issues." Proceedings of the Social Statistics Section, American Statistical Association, 280-85.
Maslow, A. (1966). The Psychology of Science. New York: Harper and Row.
Moore, E.G. (1975). "Applications of Micro-Level Data Systems in Urban Analysis." Paper presented at the annual meetings of the American Statistical Association, Atlanta, Georgia.
Moore, E.G. and S. Gale (1973). "Comments and Models of Occupancy Shifts and Neighborhood Change." Working Paper No. 1, Program of Research on Intrametropolitan Planning Problems, Department of Geography, Northwestern University, Evanston.
Morrison, P.A. (1969). Theoretical Issues in the Design of Population Mobility Models, Research Paper P-4179, RAND Corporation, Santa Monica.
Orcutt, G.H. (1970). "Basic Data for Policy and Public Decisions: Technical Aspects." Papers and Proceedings, American Economic Association 60, 2.
Revelle, R. (1968). "Introduction to Issues on 'Historical Population Studies.'" Daedalus, Spring, 353-362.
Riley, M., A. Foner, and M. Johnson (1972). Aging and Society Vol. 3: A Sociology of Age Stratification. Beverly Hills: Sage Publications
Rosemeyer, A.J. (1975). "Cincinnati's Housing Information System." Journal of Housing, 10-14.
Sheldon, E.B. and H.E. Freeman (1970). "Social Indicators: Promises and Potential." Policy Sciences 1, 1.
Taeuber, K. L. Chiazze and W. Haenszel (1968). Migration in the United States: An Analysis of Residence Histories. Public Health Monograph No. 77, Public Health Service, U.S. Department of Health, Education and Welfare Washington, D.C.
Toulmin, S. (1972). On Human Understanding. Princeton: Princeton University Press.
Westin, A.F. and M.A. Baker (1972). Databanks in a Free Society: Computers, Record-Keeping and Privacy. New York: Quadrangle.
Willis, K. (1974). Problems in Migration Analysis. Lexington: Lexington Books, D.C. Heath and Company, pp. 97-101.