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REPORT OF RESEARCH NEEDS
LAND USE EVALUATION COMMITTEE

by
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FOREWORD

This report represents work of the Land Use Evaluation Committee in identifying the critical areas of research needs in the land use - transportation planning area.

ACKNOWLEDGMENT

The major portion of the work was done by a subcommittee chaired by Professor Britton Harris. The subcommittee members are noted on page 2.

REPORT OF RESEARCH NEEDS LAND USE EVALUATION COMMITTEE

This subcommittee has been charged with the responsibility for making a broad assessment on the most important research needs in the general field of transportation and land use, essentially for the advice of the relevant research agencies.

The entire context for transportation planning has changed drastically over the past ten years, just as the availability of techniques for such planning changed in the preceding ten years. This change is based on a growing clarification, which is still in progress, of the priorities and goals of the American society. During this period, issues of racial and social equality and more recently of environmental quality have begun to become more pressing and to occupy a higher priority in some of our national and local action programs. The position of transportation planning with respect to these reordered priorities exhibits two or three distinctive characteristics.

Most important in the short run, but perhaps of minor significance in the long run, a number of transportation programs and projects have run into serious difficulties because they are accused locally of disrespect for the interests of minority groups, or of violation of the environment. More generally, this change suggests much more careful transportation planning with attention to alternate route locations and to alternates in system design--such as increased emphasis on mass transit.

The idea of more careful transportation planning can be expanded to a consideration of the total direct and indirect impacts of transportation on other metropolitan systems. Even more generally this suggests that the interactions of systems in both directions should be understood and the planning

for numerous functional systems should be undertaken jointly. In this situation, transportation planning must contribute to the philosophy and methodology of comprehensive planning, with special emphasis on environmental and social issues.

Finally, transportation planning provides indirect technical support to a wide variety of types of planning, first of all through the preparation of data files, and second through the development of methods, especially in the field of computers and modeling. This support for other planning efforts is to a considerable degree independent of the recognized interdependence of planning decisions and, indeed, may frequently precede this recognition.

Many of the research needs implied by these expanded roles of transportation planning were evaluated in very broad terms by the Dartmouth Conference on Land Use Models in the summer of 1967. The results of the conference were considered by the committee at a meeting in January, 1968, and published in Highway Research Board Special Report Number 97. The Bureau of Public Roads and other arms of the Department of Transportation also have this matter under review. The role of the committee report at this time is to provide an indication of the presently most profitable lines of research based on feasibility and desirability as judged by knowledgeable leaders in the field. These judgments, however, are not to be interpreted as substituting for more rigorous examination of the problem in the light of agency policy.

The work of the committee has been guided by three general principles. First of all, we have not undertaken to recommend marginal improvements on existing techniques simply on the grounds of technical feasibility. We have in a minor way approached each problem de novo and evaluated selected approaches. Second, we have tried to set our enumeration of research areas in the general context of the changing goals for transportation, land use, and other metropolitan planning. A third consideration has been based on changes in available

techniques. These have not been as spectacular in recent years as the changes in social priorities, but they are a powerful influence in a changing evaluation of the potential feasibility of various lines of research.

Throughout the discussions of the committee, a few points concerning methodology constantly recurred. These points are so pervasive that we will mention them at the outset, but without repetition in the detailed discussion which follows. The subcommittee felt strongly that considerable research and constant attention will be needed in the future regarding the accuracy of models, their transferability over space and time, and the propagation of errors in projection models. These provocative issues are probably not yet ripe for broad consideration. They should be examined wherever feasible and the general trend in model construction, data collection, and computer implementation should be pointed in a direction which will facilitate examining these issues in detail at a later date.

The committee identified implicitly five major clusters of research topics. These were approached in fact from a consideration of detailed needs in the field. They appear roughly in order of decreasing feasibility, but the committee reviewed the desirable priorities. Our conclusion on this count was that Group A (Improvements in Aggregative Analysis) was the lowest order of priority-- primarily because work in this field is almost certain to be undertaken in a variety of ongoing transportation studies and university research programs. We also concluded that Group D, having to do with evaluative methods, deserved the highest priority because of its immediate usefulness and because of the moderate lead-times required to develop methods in this field. Groups B, C, and E were judged of intermediate priority and were not further ranked. The complete list of aspects which are discussed below is as follows:

- A. Improvements in Aggregative Analysis
- B. Studies In Micro-Behavior
- C. Studies in Structures, Neighborhoods and Communities
- D. Central Issues in Evaluative Methods
- E. Initial Studies in Backward-Seeking Methods

In view of the fact that the foregoing list is presented in reverse order of feasibility, we should probably note that the ranking in order of need might be precisely the opposite direction. This issue remains to be examined in detail.

A. Improvements in Aggregative Analysis

Aggregative analysis may be looked at from two points of view. First, the city regions which are dealt with in urban planning and transportation studies have overall measurements of size, composition, income, expenditure, government activity, etc. The analysis and projection of these quantities forms a background for transportation studies which may appropriately be prepared by external agencies, in view of the interaction between different localities. At the same time, all of these quantities and variables are in the course of transportation studies geographically distributed within metropolitan areas by a variety of means which are more or less widely used and understood. Your subcommittee believes that the main line for the improvement of aggregated models at the sub-metropolitan area level will lie in the two classes of micro-studies discussed below. However, both at the total metropolitan level and at the sub-area level, there are some issues which need to be borne in mind in any further redesign or development of present aggregated models.

1. Estimates of total transportation demand by mode, time of day, and social classes of the population are a continuing concern for transportation planning. These estimates will increasingly be required in terms of novel transportation systems, at levels of income, and in conjunction with postulated life styles, all of which differ widely from present conditions. This will place severe demands on projection techniques.

2. Similar methods of analysis must be available at the metropolitan and sub-area levels for the demands for a wide variety of other public services. These include not only physical facilities such as housing, water supply, sewerage, and public open space, but also public and private operating services having to do with safety, health, welfare, education, trade, and services. These demands originate not only in the resident population, but also in the working population and in industry.
3. Better means are needed for assessing the rates of regional and sub-regional growth, changes in their composition and in competitive power within and between metropolitan areas.
4. Studies of service demands must be matched by studies of tax base and tax yields which provide a major part of the support for metropolitan services. Such studies and methods must of course take into account jurisdictional boundaries and governmental differences within metropolitan areas.

B. Studies in Micro-Behavior

It is by now generally recognized that the principal path to the improvement of predictive models probably lies through the more detailed study of the elements of the metropolitan system. From the point of view of behavior, these elements are individuals, households, and firms. In this section of the report we list the directions of studies having to do with the behavior of these elements which appear to offer the greatest pay off. At the same time we caution

that projective and evaluative models will not in general deal with individuals, but rather with aggregates, and that an essential part of micro-behavioral studies is the development of rules of aggregation. At the simplest level, these rules are statistical in nature. In other cases, however, where feedback exists so that some behaviors produce the environment for other behaviors, the situation may be more complicated.

1. In the area of travel demand, no complete model yet exists of individual and household behavior in relation to the needs which transportation attempts to satisfy. Nonvehicular trips, for example, are not well recorded or well understood. This is only a special case of the fact that transportation demand must be better related to system condition by way of the local environment, the situation of the trip-makers, the purposes being pursued, and by way of choice of mode, time of day of trip-making, and interaction between available destinations as evidenced by the specificity of trip-making to origin-destination pairs.
2. It is evident that the transportational, locational, and facility-using behaviors of elements in the urban system depend on a detailed and complex set of activity patterns, space use patterns, and, in the case of individuals and households, time allocations. Incomes act as constraints. Transportation is a mediating activity and not an end in itself. Studies leading to a synthesis of all of these interacting elements in behavior are urgently needed. Previous studies of elementary behaviors have not been sufficiently holistic and have paid insufficient regard to the totality of needs and constraints operating on the actors.

3. Detailed consideration of these behaviors will undoubtedly reveal interactions between daily or short-run behavior patterns and longer-run response behaviors evidenced by locational and relocational actions. Considerable research is still required in this field, since most evidence on the subject is short-run and cross-sectional in nature. Serious consideration should be given to the establishment of a national longitudinal panel of respondents for the study of this question. Other avenues of study which appear to show some promise are retrospective interviews with households such as have been used in some transportation studies, and in-depth interviews using gaming techniques to explore attitudes toward location and the environment. It is becoming evident that in this research much additional attention must be paid to the quality of the environment itself, in contrast to the conventional and still important variables of transportation services, housing quality, and space availability. Issues of environmental quality and quality of government services raises a number of issues of research technique, differentiation of variables, and so on, which must be explored.
4. There are a number of more general issues about the behavior of individuals and households, and to some extent of business establishments, which can be expressed in slightly different terms and where steps can be taken to draw more heavily on the contributions of economics, sociology, psychology, etc. These have to do with the modes of exercise of preferences and organizational decision-making. More must be known about the extent and style of satisficing

behavior or of other organizational objectives beside profit maximization. More must be understood about the mode of perception of the environment, of social space, and of business opportunities. This also implies some attention to processes of learning and the diffusion of information and of technology.

5. It may be suggested that the crystallization of some of the above studies with respect to firms and establishments in the fields of manufacture and distribution can result in a much clearer formulation of models having to do with the location and traffic generation of goods movement as distinct from persons movement. Most of the foregoing suggestions can be expanded in this direction, to such an extent that this can be said to represent a distinct field for research and analysis.

C. Studies of Structures, Neighborhoods, and Communities

From the land use point of view, the elements in the metropolitan system are not the locational actors discussed in the preceding section, but parcels of land, structures, and functional entities composed of these such as shopping centers, large integrated residential developments, neighborhoods, communities, and towns. It must be noted immediately that the larger and more diverse these units become, the less feasible it is to study them as unified systems within the metropolitan area. Planning theory in recent years has substantially de-emphasized the idea of the community as a planning element. In this section, we recognize that some disaggregation into functional entities and neighborhood

units is to a degree both unavoidable and desirable, but we also recognize the dangers involved in this step. These forms of disaggregation do not, however, separate transportation and access from the related land uses. These studies therefore ultimately point in the direction of facilitating the joint design of land use and transportation facilities at the neighborhood, town, shopping center, and business district scale. This scale has not been well integrated into metropolitan transportation and land use planning studies.

1. It now appears technically feasible and desirable to develop models in the transportation area which will unite detailed traffic assignment procedures with detailed local development down to the level of the block face, if not of the individual structure.
2. Impact models having to do with changes in transportation facilities should in general be developed at a small scale so that problems of detailed facility location and neighborhood design can jointly be studied.
3. Problems of building and structure use and re-use need study so that engineering considerations of useful life and rehabilitation can be joined with social and economic issues of building exploitation and obsolescence and with locational and transportation issues of neighborhood change, development, and interaction patterns.

4. A slightly different approach or a combination of previous approaches may be necessary to develop studies of major neighborhood perturbations such as arise in the case of the very substantial redevelopment which has taken place with the World Trade Center in Manhattan, or such as may result from the opening of a new airport or the establishment of a new major transportation terminal facility or system.

5. The preceding topics lead naturally into the possibility of developing models of sub-area and special facility function and effectiveness. Models of this type have been applied in isolated cases to buildings and to such unified developments as shopping centers, but in general they lie in the province of subjective architectural, engineering, and subdivision design. In this form they are not a suitable input into a more mathematical and computerized transportation and land use planning process.

6. A natural group of suggestions for research in this field is parallel to the suggestions made above with respect to locational behaviors. It might be practicable to select a national panel of land areas or buildings and to follow their history over time. Such a longitudinal study would be the other side of the coin from a longitudinal study of the users of the facilities. In addition, a number of special studies following up on the effects of major changes would appear to be desirable and could continue to expand the role of the impact study.

D. Central Issues in Evaluative Methods

The development of improved techniques for the evaluation of plans is obviously a very high priority in today's urban situation. This is true because of the expansion of the concerns of planning beyond economic efficiency and utility and into other realms of major social concern. At the same time, plans which are not politically and socially acceptable to a wide diversity of groups frequently will not become adopted or, if adopted, cannot be implemented. The criteria which might be applied to the achievement of social goals also can be applied to a preliminary estimate of political and social acceptability. This area of research is currently not adequately defined, and we raise here a number of issues which we believe are currently ripe for research and analysis and which will lead into a much more fully articulated approach to the entire problem.

1. The idea of the productive efficiency of the planned public systems must be explored and expanded in line with these developing planning concepts. This probably means expansion in two major directions. First, it is not clear that even the most elementary concepts of economic efficiency have yet been applied to joint plans involving transportation and other public facilities, including land use. For this reason, the ideas of cost-benefit analysis, PPBS, or cost-effectiveness need to be expanded beyond transportation effects and into other areas. In the second place, the idea of predictive efficiency needs to be expanded to include a much wider range of effects than simply, for example, savings in time, costs, and accidents. These two ideas are included in the discussions of other points which follow.

2. In measuring the effectiveness of planned systems, one of the difficult problems which will have to be studied is the fact that these effects are not simply the cumulative effects of individual systems, but result from the interactions of these systems. These interactions have at least two sides--the technical and cost interactions which result from design and feasibility considerations, and the effectiveness or utility interactions which result from trade-offs (usually non-linear) in the value systems of the users and of society.
3. The public and planners alike are becoming increasingly concerned with problems of environmental control and of the impact of planned systems on both man-made and the natural environment. In this area there are obviously serious difficulties in conceptual definition and in measurement which will increasingly have to be explored.
4. Social planning is increasingly concerned with the distributional effects of public policy, and it is apparent that even the planning of physical systems has strongly differential impact on different classes of the population. This must be an output of models.
5. The preservation of options and the provision of opportunities to various segments of the population are possible benefits of plans which must be measured and evaluated.
6. Social, personal, and business evaluations of the discount rate vary widely, and problems of this type must be carefully researched as a basis for policy evaluation.
7. An understanding of decision-makers' and popular political behavior is an essential input into the design of evaluation procedures, helping to define social goals and acceptability.

E. Initial Studies in Backward-Seeking Methods

It is a striking fact that almost all of the design activities connected with transportation and other metropolitan planning proceed without direct computer assistance. Computer methods have to do with predicting the outcomes of plans and to a minor extent with evaluating these outcomes, but not with the preparation of plans themselves or with optimizing procedures. Your subcommittee feels that the field urgently requires backward-seeking, design, or planning models, but that in a complex situation these are not easily provided. It therefore recommends a somewhat cautious and evolutionary approach towards the development of these planning and design models. In this section we recommend certain areas of exploration which appear promising.

1. In the transportation field proper, an important set of planning models would be one which would assist transportation planners in the location of facilities, in the optimization of networks, and in the planning of bus, transit, and other route systems. There is a fair literature on this topic, but many problems remain.
2. Optimizing or backward-seeking models are sensitive not only to the search techniques employed, but also to the objective functions which are postulated. The formulation of objective functions raises many problems of social evaluation. It also raises problems of individual behavior centering on information availability and questions of satisficing. It is recommended that experimental work and sensitivity testing on different formulations of these issues be tried out on reasonably well understood locational problems such as shopping centers, schools, health facilities, etc.

3. A number of research issues arise regarding the relative realism and economy of goal-seeking with growth models and with equilibrium models. This also relates to the above mentioned problem of the propagation of errors. It is recommended that exploratory researches be undertaken on the relative merits of these different approaches to planning problems.
4. Planning procedures may be strongly affected by the suboptimizing influences of political boundaries and of functional divisions of planning. An exploration of the influence of these factors on planning can point in two different directions. On the one hand, it can improve the accuracy of planning models. On the other hand, by indicating precisely how social goals and their achievement are affected, this exploration can indicate possible policy changes which would improve the performance of the total system.