PLAN EVALUATION METHODOLOGIES: SOME ASPECTS OF DECISION REQUIREMENTS AND ANALYTICAL RESPONSE

WILBUR A. STEGER AND T. R. LAKSHMANAN *

In recent years, urban developmental and transportation planning has been in flux: as policy-makers and planners come to grips with the problems posed by planning for complex urban systems open to change in many directions, they have become aware of new and broader sets of issues. The analytical framework for posing these planning issues also is trending away from simplistic end-state orientations to more appropriate functionalist foundations.

Thus, the issue and policy space in physical planning is broadening beyond earlier focus on efficient arrangements among activities in space having close functional links, to policy issues of varying dimensions at different levels of government oriented to assuring appropriate levels of public service and harmonious relations among spatially juxtaposed, if functionally unrelated, activities. At the same time, planning analysts who have emphasized a desired future state are focusing on the processes by which that state is reached, combining thereby an interest in process and a desire for goals. Transportation planners have also moved away from narrow notions of transportation system efficiency to an evaluation of externalities of transportation investments in considering the feedback effects of transportation on development patterns.

The legislative and institutional response and to some extent initiation of these changing trends have been the various Highway Acts, Mass Transit Act, the Community Renewal Program, Model Cities and Metropolitan Development Act and the creation of the U.S. Department of Housing and Urban Development. The full impact of these decisions has yet to be realized, although a basis for a continuing, comprehensive, and cooperative land use and transportation planning process has emerged.

In the same period, several metropolitan studies carried out under the auspices of these legislative decisions have pioneered the development of certain aspects of the analytical and computational technology addressed to urban land use and transportation planning. However, in the prevalent fourfold view [1] of the planning process [Goal Identification–Policy and Plan Design–

* CONSAD Research Corporation.

[1] This adds one to the trichotomy cited by Britton Harris in "The City of the Future: The Problem of Urban Design," paper presented at the Thirteenth U.S. Annual Meeting, Regional Science Association (St. Louis, November 1966).

Impact Estimation (plan testing or simulation)–Evaluation and Choice] these new techniques have been almost solely addressed to the impact estimation phase. The contextual (goal setting), synthetic (alternative plan development) and evaluation phases have received scant attention, partly because of their inherent complexities. In the evaluation area, there have been parallel developments in the areas of water resources (benefit-cost), and defense analysis (cost-effectiveness). Some attempts have been made recently to apply these concepts and techniques in developmental and transportation planning.[2] Exploratory attempts have been also evident to perceive in full the relationships between plan design, plan evaluation and goal setting and to identify the conceptual and technical problems therein.[3]

At this stage, a set of crucial questions is in order. What are the issues and policy space in current urban and regional planning? What are the emerging concerns and their dimensions? What philosophical views exist of the planning process (and its dimensions) in which to frame these issues and arrive at appropriate instrumentalities? What is the content, scope and nature of current methodologies of plan evaluation and the related plan design technology? How are control or policy variables identified and expressed? How are the effects or impacts identified and estimated in terms of magnitude and the different dimensions of incidence stratification?

Focusing on plan evaluation technology, what is the gap between the best current supply of evaluation technology and prevalent practice? What measures or procedures would most effectively bridge this gap? In another sense, what is the gap between the conceptually satisfactory requirements for plan evaluation and the capability of our public institutions and technology to meet these requirements? What would be the most promising research strategies to close this gap and what priorities can be discerned in this future research?

These are some of the challenging and complex questions before this Conference. They serve as a backdrop to this paper which is addressed to the

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[2] For example, see Robert Dorfman (ed.), *Measuring Benefits of Government Investments* (The Brookings Institution 1965), in particular the papers by Herbert Mohring and Jerome Rothenberg; CONSAD Research Corporation, *Design for Impact Studies,* prepared for the Office of High Speed Ground Transportation, 1965 James C. T Mao, "Efficiency in Public Renewal Expenditures Through Benefit-Cost Analysis," *Journal of the American Institute of Planners,* XXXII (March 1966), pp. 95-106.

[3] See Britton Harris, "The City of the Future: The Problem of Optimal Design," paper presented at Regional Science Association Meeting at St. Louis, November 1966. CONSAD Research Corporation, *Impact Studies,* Prepared for Northeast Corridor Transportation Study, January 1967, Chapter IV Marvin Manheim, "Highway Route Location as a Hierarchically Structured Sequential Decision Process," (Ph.D. Dissertation, M.I.T., 1964). Edwin N. Thomas and Joseph L. Schofer, *Toward the Development of More Responsive Urban and Transportation Models,* Research Report (The Transportation Center, Northwestern University, April 1967).

problem of evaluation. It attempts to locate the evaluation phase (or decision modeling) in the planning process, derive requirements for evaluation, identify gaps between these requirements and capabilities, and suggest appropriate long-run and short-run analytical devices addressed to these gaps.

Of the four facets of the overall planning process, evaluation is perhaps the least amenable to objective professional investigation. All citizens of a democracy have views — both descriptive and normative — of the public evaluation process. The disciplines with the most professional expertise to describe this process — the public administrators, political scientists, sociologists, and urban historians — provide us with some insights to abstract the necessary ingredients for our needs.[4] But their views are decidedly still in this very formative stage.

The subject matter does not lend itself to simplification. At a very general level, metropolitan plan alternatives must be evaluated in terms of the human ends (or benefits) they will serve, the other ends forgone (opportunity costs) and the differing means (or costs) required to achieve these ends. Each of the alternatives of an urban area is a bundle of goods with an associated set of values and life styles and a specific price tag. But as Wurster points out, it is a hypothetical package, and in the present state-of-the-art evaluation, it is very difficult to know exactly what the goods are or what the cost may be.

The objectives or ends can be compared in proximate goal statements such as housing choice, job accessibility, income or racial distribution. But the deeper indirect socioeconomic benefits are not easy to identify or assess: individual opportunity, productive efficiency, family welfare, privacy, security, cosmopolitan character and stimulus, flexibility to further change, etc. Attitudinal research informs us that we know very little about peoples' tastes and

[4] Nathan D. Grundstein, "Urban Information Systems and Urban Management Decisions and Control," paper prepared for the Third Annual Conference on Urban Planning Systems and Programs, Chicago, 1965; Alan Altshuler, "Rationality and Influence in Public Service," Public Administration Review, XXXI (September 1965); Wilbur R Thompson, "Toward a Framework for Urban Public Management," *Planning for a Nation of Cities,* ed. S. B. Warner, Jr (M I.T Press, 1966), Gilbert F. White, "Formation and Role of Public Attitudes," *Environmental Quality in a Growing Economy,* ed. Henry Jarrett (Johns Hopkins Press, 1966); Norton E. Long, "New Tasks for All Levels of Government," *Environmental Quality in a Growing Economy, ibid,* Charles E Lindblom, *The Intelligence of Democracy* (Free Press, 1965), Morton L. Isler, "Selecting Data for Community Renewal Programming," *Journal of the American Institute of Planners,* XXXIII (March 1967); David A Grossman, "The Community Renewal Program: Policy Development, Progress and Problems," *Journal of the American Institute of Planners,* XXIX (November 1963); "Process Planning· Symposium on Programming and the New Urban Planning," entire issue, *Journal of the American Institute of Planners,* XXXI (November 1965); N. Beckman, "The Planner as a Bureaucrat," *Journal of the American Institute of Planners,* XXX (November 1964)

needs, and we need conceptual frameworks to pose relationships between attitudes, tastes, needs, and behavior.

Appropriate cost comparisons among the plan alternatives may deal with private and public expenditures for major items such as transportation, housing, open space and redevelopment. Again, the forms and degrees of public power, institutions needed, and social costs of dislocation and plan enforcement all have to be assessed. In a general and rough manner, some of these cost differences among plans are estimated, while others do not lend themselves to quantitative evaluation.

If we wish to be able to progress in the assistance we provide to public decision-makers and to planners who advise decision-makers, we require a manipulable abstract view of this process, while at the same time acknowledging the breadth and variety of types of public decisions and methods to deal with them. We propose to structure our view of this evaluation process around the nature of gaps between what we want to achieve and can achieve in the evaluation area.[5] No one can really hope, at least not in the near future, to evaluate the evaluation methodologies, in theory and practice, with the precision demanded for gap-unit measures.[6]

In summary, this paper evidences a preoccupation with basic conceptual problems in plan evaluation, such as issue relevance, process context, plan design and identification of impacts and preference vectors. The neglect of technical issues, such as a choice of an appropriate discount rate, that loom large in water resource program evaluation discussions, is a measure of the novelty and youth of the field of urban plan evaluation and the challenges that lie ahead for its development.

From this perspective, we have resisted the temptation of a too innocently positivist approach. The search for feasible techniques in an area with a perplexing multiplicity, fluidity and conflict of values, the quicksand complexity

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[5] R. M. Rauner defines "gaps" as "the mediate goals against which budgets can be assigned and performance measures computed," p. 16 in "Regional and Area Planning: The EDA Experience," prepared for presentation at the Institute of Management Science Annual Meeting, April 1965; see also, R. A. Levine, "Program Budgeting for an Interagency Program," Program of the Thirty-Sixth Conference of Southern Economic Association, November 1966.

[6] Except on rather particular grounds; *e.g.*, a test of statistical validity. See D. E. Boyce and R. W. Cote, "Verification of Land Use Forecasting Models· Procedures and Data Requirements," Forty-fifth Annual Meeting of the Highway Research Board (Washington, January 1966); W. A. Steger, "Review of Analytic Techniques for the C.R P.," *Journal of the American Institute of Planners*, XXXI (May 1965); Traffic Research Corporation, "Review of Existing Land Use Forecasting Techniques," Boston Regional Planning Project, Massachusetts Transportation Commission, July 1963; and Donald D. Lamb, "Research on Existing Land Use Models," Southwestern Pennsylvania Regional Planning Commission, March 1967.

of control and effect variable dimensions, and shifting criteria, has the quality of a mirage. Consequently, we resolved to thread our way through the network of premature generalizations abounding in the field with the intent of preliminary identification of broad strategies of analytical development. It has been very sobering experience.

METROPOLITAN AND URBAN PLANNING IN CONTEXT

Two major interrelated trends in the last decade or so have been crucial in the evolution of the demand for metropolitan and urban planning. They are the evolution of national transportation policy and the evolution of national urban policy. The planning issues and frameworks resulting from these trends and the issues confronting metropolitan planners and public decision-makers are briefly surveyed in this section.

National Transportation and Urban Policy

In the area of national transportation legislation, there are two major milestones, the National Defense Highway Act of 1956 and the Federal Highway Act of 1962. The National Defense Highway Act brought to a close the era in which planning and highway planning in particular could be based on the aggregation of small locally based decisions. The planning of a large highway system required greater knowledge of urban structure and processes and required planners to become more concerned with benefits and costs of highways. The techniques of economic analysis were deployed to select a transportation plan alternative that involved the lowest transportation cost and the highest ratio of user benefits to costs.[7] Minimizing costs became the most important objective in transportation planning. The process of obtaining individual, institutional, or societal goals did not explicitly enter the planning process. Further, the indirect effects of transportation in terms of improved spatial organization or social dislocation were not considered in the evaluation of plans. Simple projections of demand coupled with a reliance on cost minimization placed the planner in the position of following trends rather than leading them.

The disaffections with the planner's function as projecting rather than planning [8] were sought to be alleviated by the 1962 Highway Act and the associated executive memoranda.[9] The establishment of an explicit metropolitan planning process intended to be continuing, comprehensive and cooperative

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[7] See Chicago Area Transportation Study *First Report*, Vol. II and IV, Chicago, 1962.

[8] See Britton Harris, "Plan or Projection," *Journal of American Instiute of Planners*, XXVII (November 1960), pp. 265-272.

[9] Bureau of Public Roads, Instructional Memoranda, 50-2-63(1), Urban Transportation Planning (10 basic elements), September 13, 1963; HHFA, "Guidelines for Five Critical Points in Transportation Planning," December 29, 1964.

was required. The plans envisioned are to be characterized by consideration of all transportation modes, comprehensive interaction of transportation factors with demographic, social and economic factors, transportation system characteristics, a need for large-scale gathering of data to support the planning process, and the representation of communities in the area on the plan evaluation aspects. Public policy-makers are becoming cognizant of the fact that transportation systems serve as key controllable variables in guiding future desired economic and social postures of the region. This new approach to transportation planning has stimulated the efforts to the development of alternative policies to be derived from the goals of society. Emphasis is shifting from a projection of impacts of transportation policies to an evaluation in a broad framework of those impacts. This development has been accompanied by the development of "backward seeking" policy evaluation model framework (see below). Thus, if a shorthand description of the emphasis in planning process in the 1950's was projection, in the 1960's the corresponding term would be evaluation.[10]

The traditional approach to metropolitan planning, borrowed from planning at lesser (*i.e.,* architectural and urban) scales and focusing on the development of a master plan in the sense of a discrete guide to future development, has been undergoing substantial modification among planners and governmental practitioners. In part, this is a recognition of the urban community as a complex web of diverse and functionally interdependent interacting parts, with the parts evolving over time as they attempt to adapt to constantly changing contexts around them. An increasing emphasis on processes by which changes are introduced that will affect future character of the city and the effectiveness with which persons and activities will be able to interact in the future has become evident. The metropolitan transportation studies, particularly the Penn-Jersey (Delaware Valley) Transportation study, concerned with interactional flows among activities, played no mean part in this evolution. About the same time the enactment of legislation for Community Renewal Programs, though not explicitly concerned with metropolitan planning, vastly expanded the functional scope of urban land use planning and set the stage for identifying alternative policies whose consequences could be estimated and evaluated.[11] The recent establishment of the Department of Housing and Urban Development has provided a further impetus to metropolitan planning.

Thus, in summary, metropolitan planning today has both an interest in process and a desire for identifying goals. Alternative policies and plans are derived from these goals and their impacts estimated and evaluated. An emphasis on a broad range of impacts (magnitude and several dimensions of

[10] See J. L. Schofer and F. J. Wegman, *A Transportation System Plan Design Model* (Northwestern Technical Institute, March 1966), Chart I.

[11] See Wilbur A. Steger, "Review of Analytic Techniques for the CRP," *Journal of the American Institute of Planners,* XXXI (May 1965).

impact stratification) of alternative policies and a focus on a multidimensional evaluation of these impacts are emerging in urban planning today.

Emerging Metropolitan Policy Issues

Emerging metropolitan issues, naturally, assume many forms: to Wilbur Thompson, "Urban-regional economics is just now coming into its own . . . [having] more than its share of the gut-issues of the day."[12] To Wingo, the issue is primarily a problem engaging "the whole institutional machinery for land allocation," so as to rationally consider "the spatial dimension of the accelerating urban revolution."[13] It assumes many forms, the clichés carrying their share of the objective truth: quality of the environment, slums and suburbs, the white noose, high central densities and amenities, magnetic vibrant downtowns, chaotic urban responsibility, total (national) responsibility for the ghettos and public welfare, no quick cures for congestion, the neighborly life, etc.

For a significant part, the issues revolve about the costs, benefits, and incidence of public investments and/or private investments affected by public actions in urban areas. These include the short and long-term effects of these investments on the stability, growth, and well-being of the combined private and public sectors.[14]

That we are speaking of enormous magnitudes is obvious. A recent study by TEMPO for the Executive Committee of the National League of Cities estimated that the total revenue needs for local governments in the decade to 1975 would exceed one trillion dollars, or an implied revenue gap, even extrapolating today's sources, of more than one-quarter of this total. The *Nation's*

[12] Wilbur R. Thompson, "Programs for Metropolitan Area Economic Growth," a paper prepared for the Third Regional Accounts Conference, November 1964.

[13] Lowden Wingo, Jr., "The Uses of Urban Land: Past, Present, and Future," Resources for the Future, Reprint No. 39, July 1963.

[14] No suggestion is being made here that these issues are entirely novel. Concern with improving the quality of our environment associated with the benefits of compact habitation is cited in literature of the eighteenth and nineteenth centuries. See O. C. Herfindahl and Allen V Kneese, *Quality of the Environment,* Resources for the Future, 1965, pp 53-54. Also, nineteenth and early twentieth century public concern for the slums, the poor, the market for low-income housing, and the role of inferior uses of land, are cited by Lowden Wingo, Jr., "Urban Renewal: Objectives, Analyses and Information Systems," a paper prepared for the Third Regional Accounts Conference, November 1964, pp. 7-8. Nevertheless, what is novel is the scale of public investment and the concern that the costs and benefits have an explicit and agreeable incidence. Also novel is concern with the *total* environment. "The formulation of an ideal environment should take into consideration all aspects of man's life including his emotional needs and the development of his civilizations." René Dubos, "Promises and Hazards of Man's Adaptability," *Environmental Quality in a Growing Economy,* ed. Henry Jarrett (Johns Hopkins Press, 1966), p. 37.

City special report, "What Kind of City Do We Want?" estimated that, between now and the year 2000, in real terms, "the money needed to build and rebuild our cities twice as big and twice as good will average out to over $100 billion a year": almost one-third would be for all new and better community facilities of all types.[15] Estimates of public service investment for each new household in the New York region is anticipated to be $16,800 in real terms.[16]

Viewing metropolitan issues in a framework of public investment concerns, at least three dimensions of issues are apparent.

Public Investments and the Geographic Hierarchy Issues. Public investments in urban regions of a mature, developed nation play a many-faceted role in the pursuit of development and distributional objectives. A direct impact of public investments is their income generation role through their stimulation of demand for goods and services.[17] These projects also have effects on human capital, improving its productivity and thus augmenting the regional production of goods in the long run. Again, by reducing factor costs, these projects generate internal economies for many sectors, thereby fostering external economies for all sectors. Further, public investments in certain regions, by generating growth in new sectors, may result in larger urban functions, in upgrading of the centers in the urban hierarchy, and in consequent urbanization economies that spur further growth.

Thus, the public investments generate a wide range of benefits, other effects, and incur attendant costs. An identification and measurement of these consequences and costs must be done through an overall appreciation of the economic panorama in the affected metropolitan areas, among regions, and the nation. Such an analytical framework, following Hoover, would investigate the impacts of public investments from:

- the *locational* viewpoint: the role of public investments in improving the comparative advantage for specific industries, population groups, etc.;
- the *regional* view: the interrelations among projects in terms of their impacts within the region over time; and
- The *interregional* view: the economic interrelationships among sectors, between regions, over time, resulting from these projects.

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[15] "What Kind of City Do We Want?" *Nation's City*, April 1967.

[16] Regional Plan Association (New York), Bulletin 100, "Spread City," September 1962; see, also, the National Planning Association Study on national goals by Louis Lecht.

[17] These effects are relatively easier to trace at the national level as payments for domestic factors of production. At the regional level, they are a function of interregional, interindustry linkages that determine the proportion of local productive inputs in the region.

This specifies one dimension of the issues' space, the geographical hierarchy: the Federal, interregional, subregional, urban and intraurban. This spatial hierarchy can be used to exhaust a wide variety of issues: the growth and cyclical stability, in relevant economic and social activities, at different levels of the geographical hierarchy. Similarly, comparative advantage theory can be applied to study the relative impacts of alternative mixes and quantities of public investment at different area levels. Most of the spatial, that is external, effects of location can be isolated within the spatial dimension.

The Public Versus Private Sector Issues. Another very important issues' dimension is that of the public versus private nature of infrastructure investment. If the geographical hierarchy issue is directed to what is to be done, this issue's area raises basic questions of how it is to be done.

There is nothing, *per se,* inviolate about the private nature of existing private sector investments. The line can, and has recently, moved across the spectrum of infrastructure investment types, as has the role of the various levels of government within the public sector. The latter involves the choice of revenue and expenditure incidence, and thus, client group redistribution, which is, of course, another important issues' dimension.

The public-naturedness of an investment is rarely a planning issue at the urban or regional level although it almost certainly should be a major one. The parameters of this dimension include:

- *The presence or absence of externalities,*[18] and the degree to which these can be measured, their incidence discovered, and redistributions accomplished or explicitly denied.[19] This latter possibility should be of particular interest to the urban-regional planner, since his expanding tool kit of analytic methods and information availability could substantially alter the previous externalities' determining equilibrium point.

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[18] O. A. David and A. S. Whinston, "The Economics of Complex Systems: The Case of Municipal Zoning," *Kylos,* 1964, pp 419-446; James W. Buchanan and William Craig Stubblebine, "Externality," *Economica,* 29 (1962); Ralpha Turvey, "On Divergences Between Social Cost and Private Cost," *Economica,* 30 (August 1963); A. Breton, "Towards an Economic Theory of Pollution Control and Abatement," London School of Economics, *Background Paper,* D29-1, 1966; O. A. Davis and A. B. Whinston, "Some Notes on Equating Private and Social Cost," *The Southern Economic Journal,* 31 (October 1965); J. M Buchanan, "Joint Supply, Externality, and Optimality," *Economica,* 33 (November 1966).

[19] G. M. Neutze, *Economic Policy and the Size of Cities* (The Australian National University of Canberra, 1965); J. A. Stockfish, "External Economies, Investment and Foresight," *Journal of Political Economy,* 63 (1955), pp. 446-449; R. N. McKean, "Some Problems of Criteria and Acquiring Information," in H. Jarrett, ed., *op. cit.,* pp. 63-65

- *The presence or absence of structural effects,* due to "the response in parameter changes in the technological, social, and economic organization of the metropolitan region."[20] At the very least, improved knowledge of the structural processes in the private sector can improve the planning and development achieved for public sector investment. At the other extreme, the structure can be manipulated by public investment and/or by converting previously private investments into the public category.
- *The feasibility and desirability of introducing, for external cost or net social benefit reasons, regulatory and/or pricing mechanisms.*[21] This is a major policy issue and yet it is rarely the subject of the planner's choice space. This is surprising because the choice frequently depends on the comprehensiveness, interrelatedness, and complexity of the urban-regional system under consideration, a subject matter quite familiar and important to the planner.
- *The feasibility and desirability of determining public demand, in the absence of a price system* Interpretation of voting statistics, budget-constrained time preference surveys, sociological and cultural interpretation, price-system proxies, and other methods: these have all been suggested as methods for estimating present and future public demand. These are recommended as short cuts for the difficulties of (a) interpreting individual preference functions, (b) aggregating them, or (c) predicting what they will be. Planners rarely enter this issues area systematically, although they do attempt to help communities explicitly state their competing goal structures.
- *The presence and extent of scale economics.* This should be a major dimension structuring the planner's view of the urban management functional systems, by area and subarea. Certainly at the regional level, the system of cities and supporting areas should be highly sensitive to the presence and extent of these economies. Furthermore, these economies can assume many forms, *e.g* transportation effects (intercity, intracity, parking, etc.); public sector goods and services effects (utilities

[20] L. Wingo, Jr., "Urban Renewal: Objectives, Analysis, and Information Systems," *op. cit.*, p. 14; also, W. Thompson, "Programs for Metropolitan Area Economic Growth," *op cit.*, p. 12

[21] Davis and Whinston, "The Economics of Complex Systems," *op. cit*, pp 442-443; Allen V. Kneese, "Research Goals and Progress Toward Them," in H. Jarrett, ed., *op. cit*, pp. 72, 87.

and other); private sector goods and services effects; and other effects (land values, design potential, information and coordination potential, etc.). Nevertheless, planning information systems have not been geared to assist in this most important determinant of public-naturedness, our costing systems being totally inadequate for even Planning-Programming-Budgeting Systems, let alone the determination of total systems cost (capital plus operating, properly discounted).

This general lack of involvement of planners in the arena of public-private sector debate is particularly unfortunate because the following trends toward increased rationalization of planning activities [22] call for an intelligent, informed view of this issues area:

- With immense changes of real income, per capita anticipated, *e.g.*, a fivefold increase in 70 years, there is great need for responsible, long-run planning for changes in the tastes of the public, both for public and private goods;[23]
- With the intensification of jurisdictional interdependence, there is increasing need for an appropriate multiple hierarchy (in an areal sense) pricing system, or other relatively automatic and impersonal rationing devices;[24]
- With the decline of blue-collar workers, the urban environment will exist almost exclusively for decision-making, information processing and communication functions,[25] and with the increasing socialization of problem solving,[26] the *productivity* of decision-making and private and public planning will become increasingly recognizable and measurable;
- With the increasing cost of defining alternatives to examine, and collecting and processing the relevant information, there is recognition that a major role of planning is to choose those is-

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[22] Donald N Michael, "Urban Policy in the Rationalized Society," *Journal of the American Institute of Planners,* XXXI (November 1965), pp. 283-288.

[23] W. A. Steger, "The Management Sciences: The Future Users," a paper presented at the Institute of Management Sciences Annual Meeting (Boston, April 1967).

[24] William Wheaton, "Metro-Allocation Planning," *Journal of American Institute of Planners,* XXXIII (March 1967), pp. 103-107

[25] R. L. Meier, *Communications Theory of Urban Growth (M.I T. Press,* 1962).

[26] H. G. Johnson, "The Social Sciences in the Era of Opulence," *Canadian Journal of Economics and Statistics* (November 1966)

sues to which planning and study resources are to be allocated;[27]

- With planning, design and architectural inputs so labor intensive, productivity is not likely to increase in these sectors at the same rate as other urban-oriented sectors, and planning will have to assume a vocal role to ensure that savings generated from the productivity increasing sectors are passed on to the planning sector;[28] and
- With increasing emphasis upon the economies and productivity due to concentrating human capital in dense urban areas, there will be greatly increasing attention paid to the allocation of scarce land resources — "space" being the major "urban-peculiar" intensively utilized factor of production.[29]

All of these offer reasons for the planning profession to be engaged more actively in important public-private area controversies, in addition to the spatial, physical, economic and social consequences of alternative public investment plans.

Incidence Issues. The final issues' dimension, briefly alluded to above, is that of the incidence of the effects of public and/or private investment choices, *i.e.*, the distribution and redistribution consequences. A major weakness of planning studies is their scant attention to the question of incidence of benefits. Public investment projects are often prepared for different client groups and also may affect a variety of other client groups in an indirect manner. For many planning projects, a basic focus is the effect that public investments may have, directly or indirectly, on low-income or high-unemployment subgroups of the population.

Several issues are important here. The characteristics of the local community where the public investments are located influence to a great degree the incidence of the benefits. Thus, the employment status, occupational or industrial affiliation, of the persons in the community may be highly relevant to them capturing the benefits occurring from a public investment project.

Again, there are spread effects of public investments from the locales which receive the investments to a few areas in the vicinity. No empirical evidence is available to infer these spread effects. However, public investments in some

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[27] M. Webber, "Comprehensive Planning and Social Responsibility," *op. cit.;* L Wingo, Jr., "Urban Renewal: Objectives, Analysis and Information Systems," *op cit.* pp. 5-6.

[28] This argument is due to William Baumol's discussion of planning for urban growth in an "unbalanced" economy.

[29] H. Liebenstein, "Long-Run Welfare Criteria," *The Public Economy of Urban Communities,* ed. Julius Margolis (Resources for the Future, 1965).

urban areas or urban growth poles improve their comparative advantage vis-à-vis other places, thereby resulting in spread effects from that growth pole to adjacent areas — suburban or otherwise. Such spread effects may not be incident to a great degree in lagging regions. An investigation of these differential spread effects involves explorations of different characteristics of the communities in growth poles versus lagging regions. On the other hand, the spread effects may be understood in terms of interindustry linkages among different regions.

The delineation of these types of incidence is no easy matter. One set of estimates required is the change in number of families in different income groups in areas where public investment projects are made. However, certain aspects of incidence, for instance the temporal aspect, are even more difficult to discover. For these, what is required is the development of a framework posing the problem of incidence of project benefits. These frameworks then may suggest further analytical work into this problem. An example of this formulation may be a three-dimensional array of benefit incidence, the dimensions being the different income groups, types of public investments, and temporal — temporary or permanent — benefits.

In summary, the metropolitan policy issues requiring in-depth planning consideration and evaluation are all concerned with infrastructure investment: first, the geographical distribution, for growth, stability and comparative advantage reasons; second, the responsibility of the public sector; and third, the distribution effects. These are the classical economic issues of efficiency, equity, and non-competitive system effects.

VIEWS OF THE PLANNING PROCESS

This section is addressed to a description of the planning process in some detail, to help locate the role of evaluation in this process.

Models of the Planning Process

In general, the metropolitan planning program (Fig. 1) is one in which: (a) future regional needs and challenges are anticipated, (b) alternative strategies addressed to these issues are forced, (c) the crucial impacts or outcomes of each of the alternative planning strategies stated above (in b) estimated, and (d) the evaluation of alternative plans or designs based on more or less general criteria applied to the delineated impacts.[30]

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[30] We borrow most heavily, here, from knowledge of the following studies: Detroit Land Use and Transportation, Bay Area Transportation; Penn-Jersey (now Delaware Valley) Transportation; Southwestern Pennsylvania; Southeastern Wisconsin; Baltimore Regional Planning Council, and several (previous and existing) Community Renewal (and Analysis) Programs, in particular, Los Angeles, New York City, Pittsburgh, San Francisco and St. Louis

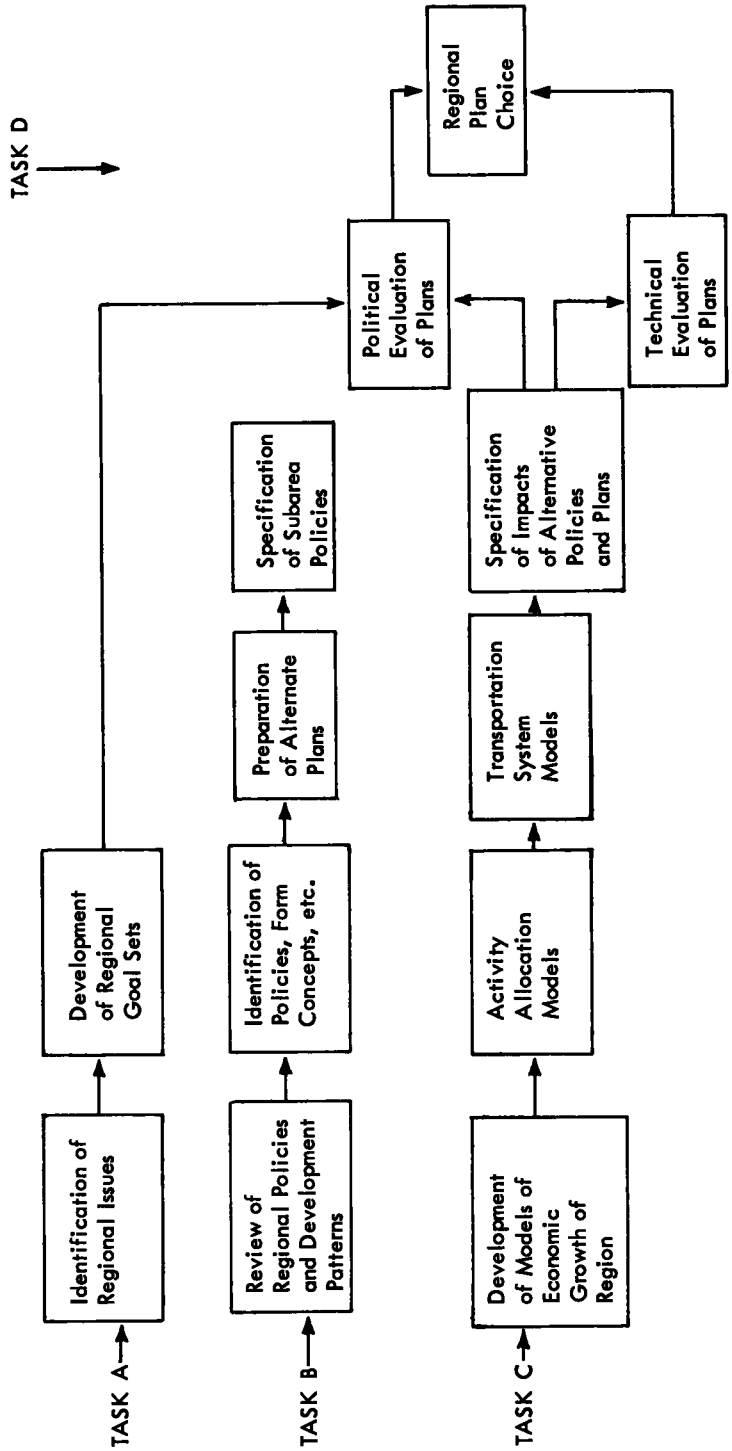

Figure 1. A simplified model of a regional planning work program.

This process is largely to be regarded as cyclic and continuous. The impacts and evaluation of one set of metropolitan plans may well suggest a return to the process of synthesis for fresh generation of alternatives. Again, the evaluation criteria themselves derive from regional goals that influence the development of alternative plans and indeed may guide the choice of the policy or instrumental variables appearing in these alternatives. Further, as future regional needs are reassessed, the process feeds back into itself. Thus, planning must be viewed truly as a continuing comprehensive process.

Such a process by its nature calls into play a creative, subjective, and synthetic thought process on the one hand and an analytic and objective effort on the other. Thus in contextual (goal setting) and synthetic (development of plan alternatives) phases of planning, a great deal of imagination and subjectivity are called for in identifying what goal sets are desired and how existing or new structural and form elements can be combined to produce desired metropolitan futures. However, in the phase of "plan testing" or estimating the impacts of outcomes of alternative policy bundles, analytical techniques play a crucial part.

The last statement needs some elaboration. The impact estimation phase involves essentially the establishment of the functional relationship between the control or instrumental or policy variables which are crucial to plan selection. These interrelationships are often very complex and difficult to trace and understanding of these underlying relationships is the focus of many land use or regional growth models.

The process of evaluation ideally involves the establishment of an overall criterion for evaluation and selection from among alternative plans in terms of their impacts (benefits and costs) This implies that various types of impacts would have to have weights attached to them relative to one another to help in this grand choice. It must be obvious that a sophisticated knowledge of the value system and its dynamics is called for if such a task is to be undertaken fruitfully. Such knowledge should embrace estimates of tradeoffs among values and the degree of satisfaction of these values in a commensurate fashion.

The planners can hope to elucidate this problem in cooperation with social scientists in developing over time a greatly enriched and multidimensional benefit-cost analysis that explores peoples' goals and desires in their plurality and communality. The set of interacting values that are mediated by societal and technical relationships (determining the rates of tradeoff) are expected over time to be exposed for the public consideration and decision-making. In this way, decision-making is anticipated to be assured considerable objectivity and a broader participation.

Such are the theoretical underpinnings of the planning process of the more sophisticated metropolitan studies. They suggest techniques that are in many respects futuristic and non-operational. Consequently, as mission-oriented agencies, the work program describes the essentials of an operational strategy to plan development and evaluation from the complex (and at places intracta-

ble) planning methodology, outlined above. Such strategies are designed to reflect the resolution of the tradeoffs among various complex aspects of goals definition, design, and evaluation of the future regional plans.

The planning process poses a number of very imposing demands for the policy-maker. Such requirements include a specification of goals and values and agreement in advance, wide canvassing of plan alternatives addressed to these objectives, a similarly systematic analysis of consequences of each alternative, and for policy choices to be evaluated against the selected goals. In practice, the selection of goals is a very tricky and difficult political process; complete information on relevant measures of all consequences is not always possible to develop and, when developed, difficult to comprehend; and, finally, the requirements of evaluation pose conceptual and technical problems. These considerations have persuaded some theorists, including Braybrooke and Lindblom, to suggest a strategy of "disjointed incrementalism" such as the following: [31] describe the metropolitan system; identify problems in the system; establish short-term objectives; generate alternative plans for problem solution; and evaluate plans in terms of short-term objectives.

It is believed that decision-makers focus on incremental alterations of existing social states rather than an erection of rationalist, deductive, long-run metropolitan system.

In this process, one begins by using a descriptive model of the metropolitan system without making long-run predictions because it is assumed that decision-makers in the political milieu will tend to seek solutions which ameliorate existing problems rather than allow an approach to a set of predetermined goals. For this reason, although one wishes to use the most comprehensive, most accurate and most precise descriptive models available, almost any incremental description is suitable for getting to the next step provided that it is generally believed to be a reasonable description of reality.

This next step is the step in which we identify problems in the system. Identification of problems implies value structures and goals, but here one is able to side-step the problem of goal setting because very often two individuals or groups with conflicting goals will agree to the existence of a problem and call for its solution or eradication. Problems will appear as misallocations, gaps, and functional misfits. Most problems lend themselves also to be broken down to smaller problems.

Having identified problems, it is necessary to establish some very short-term objectives for problem solution. These objectives would be problem avoidance or problem amelioration objectives rather than positive goals.

Then one generates alternative plans to meet these objectives. Since an incremental approach is being taken to generally agreed upon problems, plans can be developed problem by problem and interdependencies between problems can be considered after solutions are found. The important thing is to

[31] David Braybrooke and Charles E Lindblom, *A Strategy for Decision Policy Evaluation as a Social Process* (New York: The Free Press of Glencoe, 1963).

generate plans which cover the full range of feasible choices open to decision-makers.

In the evaluation stage a more limited view of the scope of evaluation is adopted. Again, plans must be evaluated in terms of problem-oriented objectives for the comparison between plans. The evaluation of the plans can then continue by applying the rather less sophisticated evaluation techniques which are less demanding than the social welfare functions implied in the previous model. The incremental planning process is intended for some of the problems which have been identified for which the relevant variables in the process can be forecast. This portion can be performed on a limited and selective basis.

Dimensions of the Planning Process

These two models obscure many of the underlying dimensions of the metropolitan planning-decision process. Identifying those "dimensions" should help in clarifying the choices planners and analysts have already made in establishing the process as described. It should also indicate choices which remain to be made in improving this process.

The nature of this process, in each instance, is conditioned by the relative emphasis that a planning effort places upon each of the following approaches [32]

Forward Versus Backward-Seeking Processes.[33] Backward-seeking processes automatically precalculate, in a time-phased manner, all that is required to achieve an end state, optimally. The appropriate land use forms, socioeconomic changes, and transportation links are staged endogenously within the process. If models are involved, these analytically create, for instance, the set of networks which produce alternative desired regional configurations for any given multiple-goal objective function.[34] Most current studies are forward seeking, where alternatives for manipulating the modeled environment toward an implicitly or explicitly stated set of goals are chosen carefully for test.[35]

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[32] These dimensions are not completely orthogonal with respect to one another, nor are they listed in order of importance.

[33] H. W. Bruck, "Problems of Planning for the Future: The Marriage of the White Queen and Tiresias," paper presented at the National Transportation and Railroad Symposium (San Francisco, May 1966)

[34] H. W. Bruck, S. H Putman, and W. A Steger, "Evaluation of Alternative Transportation Proposals: The Northeast Corridor," *Journal of the American Institute of Planners*, XXXII (November 1966), pp. 322-333.

[35] A notable exception, with its emphasis on transportation and land use design optimization, is the Southeastern Wisconsin Study. Report No. 7, *Forecasts and Alternative Plans, 1990* (Southeastern Wisconsin Regional Planning Commission, June 1966).

Multiple Versus Single Goals. With the advent of the writings and thinking of Carroll,[36] Holmes,[37] Garrison,[38] Fagin,[39] and Bureau of Public Road manuals and other publications,[40] a number of transportation related, economic, social, regional planning, aesthetic design, and general criteria are now essential parts of the overall process. Various measures are recommended such as benefit-cost ratios and rates of return for transportation efficiency, qualitative measures for performance and design, accessibility and cost measures for economic efficiency, cost and accessibility measures for social criteria.[41] Arbitrary, but explicit, weighting schemes are then applied to these multiple measures. The trend in existing studies is, of course, towards the multiple criteria and multiple measures.[42]

Planning Versus Policy Making. While, at one time, it was generally accepted that urban and metropolitan planning should be non-political, there is increasing communication between the professional planner and the policy-makers of governmental units. The criticism of their non-political role and responsibility has led to a number of proposals, including a variety of new political forms. The preparation and review of metropolitan issues; the development of goal sets; the development of alternatives; the review of regional policies and development patterns; the generation of policies, form concepts and structural aspects; and the preparation of alternative plans and subarea policies: these all will be affected by the subtle changes already taking place in the planner-politician relationship.[43]

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[36] J. Douglas Carroll, Jr., *Urban Transportation Research,* HRB SR69, 1962

[37] E. H. Holmes, "Why Transportation Planning?", Bureau of Public Roads, May 1964.

[38] W Garrison, *et al*, *Studies of Highway Development and Geographic Change* (University of Washington Press, 1959) See, also, N Irwin, "Criteria for Evaluating Alternative Transportation Systems," a paper prepared for Highway Research Board, Forty-Fifth Annual Meeting, January 1966.

[39] H. Fagin, "Urban Transportation Planning Criteria," The Annals of the American Academy of Political and Social Sciences, March 1964.

[40] *Guide for Highway Impact Studies,* 1959; *Manual 9, Social and Community Value Factors,* prepared for the Ohio Department of Highways by Vogt-Ivers and Associates, 1966; Jacob Silver and Joseph R. Stowers, "Population, Economic and Land Use Studies in Urban Transportation Planning," July 1964.

[41] Southeastern Wisconsin, *Volume II, op. cit;* also, Bureau of Public Roads, *Manual 9, Social and Community Value Factors, op. cit.*

[42] Alan A. Altshuler, "Rationality and Influence in Public Service," *op. cit.;* also, Altshuler, "The Goals of Comprehensive Planning," *Journal of the American Institute of Planners,* XXXI (August 1965).

[43] Bernard J. Frieden, "Toward Equality of Urban Opportunity," *Journal of the American Institute of Planners,* XXXI (November 1965); Melvin M. Webber, "Comprehensive Planning and Social Responsibility," *Journal of the American In-*

Planning Versus Functional Control Operations. In contrast to most planning problems, which are concerned with determining whether or not feasible solutions exist, governmental control and control theory concerns itself mainly with findings and optimal solution, assuming that feasible solutions exist. Thus, to the degree that planning assumes a more backward-seeking theoretical base, the more control aspects it will assume as responsibilities. Furthermore, planning is becoming more concerned with changing (or advocating changes in) goals and restrictions which make certain plans unfeasible, which is a complement to the control process. Other dimensions related to planning versus control are feasibility versus optimality, where the objective function can or cannot be defensibly constructed, acceptable to all members of society, and the duration over which the plans are to be effective. Most transportation and land use plans are designed to be effective over a medium to long range; however, there is increasing emphasis placed on short-term planning requirements, with advocates calling for explicit requirements for short-term programs and concrete provisions for short-term action, such as is imposed (or proposed) for urban mass transportation, water and sewer facilities, and open space land program planning Another related dimension is that of planning versus functional management decisions; clearly, most planning has not been and will not be involved with the operational aspects of managing currently operating metropolitan service facilities. Nevertheless, there is increasing realization that many of the cost, benefit, effects, and incidence data are an important by-product of current functional agency operations, and planning familiarity is necessary for planning to make correct operational and control assumptions. One consequence is that the transportation and land use planning process frequently has ignored important and relevant functional areas, such as housing, where the operational and current management decisions are so crucial and frequent as to overshadow the true merits of longer-range planning. Increasingly, functional areas such as housing and recreation are being considered as detailed subject matter for regional planning studies, along with transportation and land use

Comprehensive Versus Particular Problem-Solving. The first four dimensions are aspects of the overall "degree of comprehensiveness" dimension. This takes many forms, all of which are tied to the planner's concept of the metropolitan region as a complex social system, for which public resource allocation has to be performed "as a whole." Nevertheless, the degree of "wholeness" — the number of functions to be viewed as interacting simultaneously and rele-

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stitute of Planners, XXIX (November 1963); Paul Davidoff, "Advocacy and Pluralism in Planning," *Journal of the American Institute of Planners,* XXXI (November 1965); U S. Senate Committee on Government Operations, Subcommittee on Intergovernmental Relations, *The Effectiveness of Metropolitan Planning,* June 1964

vant to a specific problem — is, itself, increasingly viewed as a subject for cost-effectiveness analysis. The lack of intensive use of the largest of the models — the Pittsburgh model and the San Francisco model — is partially due to the large cost (computer time for the San Francisco model) or, in the view of the current head of Pittsburgh City Planning, the overambitious nature of the Pittsburgh model which seeks to account for so many individual decisions.[44] Problem-solving efficiency increasingly is being seen as a process to be rationalized, itself, and planning agencies are learning to better "package" problems and problem-solving mechanisms to take advantage of joint costs and benefits.

Physical Versus Social Planning. Planning has learned to extend interests beyond physical locational arrangements so as to avoid the imposition of disproportionate costs upon one client group in order to benefit another unless suitable compensation is or can be made. Increasingly, planning programs—particularly Housing and Urban Development 701 Programs — are subject to criticisms if they lack substantial reference to the social or economic impacts the plans might have, and the incidence of these impacts.[45] The obsolescence of merely locational planning is particularly relevant to transportation planning in a developed economy, since several recent studies, in particular the Penn-Jersey land use models, confirm the earlier observation that "today highway improvements are effected in a developed economy which has an extensive transportation system and where improvements continue to whittle away at spatial imperfections and further reduce the value of situs . . . one should no longer expect gargantuan dislocations because of improvements providing access to land of greater productive capacity . . . nonspatial relationships appear to be of even greater importance."[46] Analogous reasoning has extended to critical evaluation of the use of quantitative cost-benefit indices in social planning; *e.g.*, planning resource allocation for the poverty program.[47]

Automation Versus Manual Operations. Naturally, the trend is toward increasing use of computers in the entire process. It is possible to characterize

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[44] The Planning Commission apparently also believes that relatively "narrow objectives," such as developing a strategy for racial balance in the school system, or extensive clearance in one area, could be assisted through the use of the model and that, eventually, a large-scale testing of numerous alternatives could ultimately be achieved. Bernard Fuchs, "Federal Comprehensive Urban Planning Grants," U.S. Bureau of the Budget Memorandum, November 1966

[45] See the contributions by Ira M. Robinson and Harvey S. Perloff in the *Journal of American Institute of Planners,* XXXI (November 1965)

[46] Robert H. Stroup and Louis A. Vargha, "Reflections on Concepts for Impact Research," a paper presented at the 40th Annual Meeting of the Highway Research Board (Washington, January 1961).

[47] Martin Rein, "Social Science and the Elimination of Poverty," *Journal of the American Institute of Planners* XXXIII (May 1967).

their role in a forward-seeking process by examination of the shaded areas of Figure 2.[48] Here, much of the estimated impact and incidence information is calculated for each alternative investigated by the use of a computerized land use-transportation systems simulation effort, drawing upon a partially or wholly automated stored information source. Much of the process is manual in this forward-seeking version. However, development of methods for calculating efficient sets of choice possibilities,[49] estimating community needs and values,[50] and determining "optimal" project-program mixes [51] are all the targets of analytic methods of the next decade but are clearly not yet available for practical application, across the board, in forward-seeking processes. The backward-seeking process, on the other hand, also will lend itself to automation of these features, leaving only the decision-makers' *ad hoc* information sources and confidence checkout techniques of Figure 2 free from the influence of automation.

EVALUATION METHODOLOGIES

This section provides a description of the framework for articulation of the evaluation problem, the requirements for evaluation and some previous attempts at grappling with this problem. This discussion essentially focuses on conceptual and fundamental issues in evaluation and turns to questions of detailed method and technique only minimally.

Goal Identification

Crucial to the process of successful regional planning is a clear understanding of regional goals. Far too often, planning has been beset with difficulties resulting from a failure to use an explicit consensus of goals and objectives as a base. The more sophisticated studies are extremely conscious of this and engage in the task of delineating realizable goals. The opportunities and challenges for developing the region are viewed in the aggregate and a broad set of general region-wide goals developed. Some goals of the region are implicitly understood by each citizen and by the community forces that comprise the

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[48] This is a modification of a figure developed by Nathan Grundstein for the Pittsburgh simulation effort See Grundstein, "Urban Information Systems and Urban Management Decisions and Control," *op. cit.*, p. 5.

[49] Marvin L. Manheim, *Hierarchical Structure: A Model of Design and Planning Processes,* M.I T. Report No. 7 (M.I.T. Press, 1966)

[50] William C. Birdsall, "A Study of the Demand for Public Goods."

[51] W. A. Steger, "Analytic Techniques to Determine the Needs and Resources for Urban Renewal Action," Proceedings of the IBM Scientific Computing Symposium on Simulation Models and Gaming, December 1964; Robert C. Meier, "The Application of Optimum Seeking Techniques to Simulation Studies: A Preliminary Evaluation," *Journal of Financial and Quantitative Analysis,* 2 (March 1967)

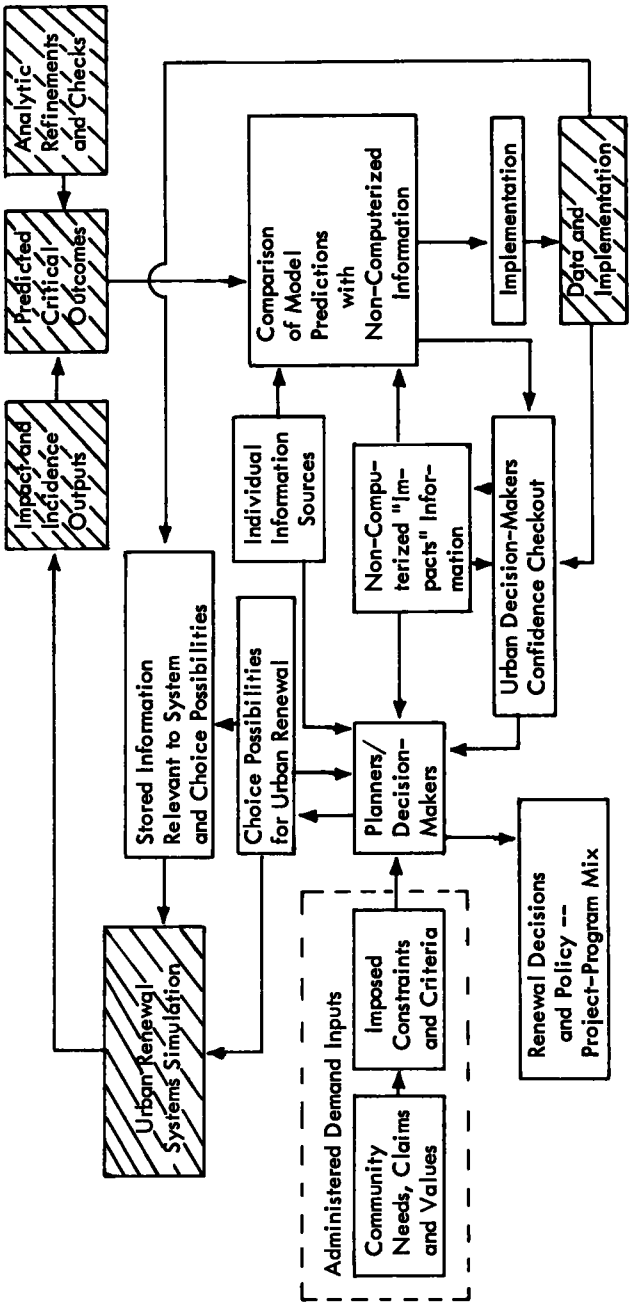
Analytic Refinements and Checks
Predicted Critical Outcomes
Impact and Incidence Outputs
Comparison of Model Predictions with Non-Computerized Information
Implementation
Data and Implementation
Individual Information Sources
Non-Computerized "Impacts" Information
Urban Decision-Makers Confidence Checkout
Stored Information Relevant to System and Choice Possibilities
Choice Possibilities for Urban Renewal
Planners/ Decision-Makers
Urban Renewal Systems Simulation
Administered Demand Inputs
Imposed Constraints and Criteria
Community Needs, Claims and Values
Renewal Decisions and Policy -- Project-Program Mix

Figure 2.

functional economic, social and political groups within the region. Implicit goals, however, must be set forth explicitly in the agency so as to develop a framework for programs of action that do represent the synthesis of collective need. These goals also provide a basis for identifying the leverage for alternative development patterns.

Many agencies conduct substantial analysis of data on socioeconomic variables and physical variables such as housing, land use, and transportation of all modes. From such informational bases, an attempt is made to identify to the extent possible the requirements suggested by the goals. Further, a general interpretation of the association between what is desired and the sort of control (or instrumental policy) variables to bring them about is often attempted. In addition to these formal and semiformal attempts, informal inquiries with key persons and groups have been helpful in identifying general development goals in the region. These regional goals may be specified over time and refer to various dimensions such as transportation, land use arrangements, and economic growth.

In the identification of goals, it may be conceptually satisfying to recognize two broad categories of goals performance goals and contextual goals. Performance goals and associated outputs are directly related to the performance of the system under review. In the case of a transportation system they refer to performance characteristics of the system. The contextual goals arise because of the way performance goals are realized. In the case of an urban area, visual beauty, pollution abatement, and noise reduction are examples of contextual goals that may be expressed in terms of threshold levels to be assured. It may be that a contextual goal of an earlier period, once recognized, may be incorporated into the performance goal structure at a later point in time of a region.[52]

Another point to recognize is that an urban system has multiple goals and the planner might want to specify an explicit utility (or trade-off) function that transforms all goals into a single compound goal. Different goals in the urban area are often hopelessly incommensurable in the sense that no general consensus exists as to the trade-off among them. In such a case, a spurious trade-off function suppresses information about alternative plans rather than simplifying the selection process.[53]

Sometimes, the global objectives of a large system such as an urban region, can be factored into a hierarchy of more manageable subobjectives.[54] This is done through a means-end analysis that relates the desired end results to the means of accomplishing them. However, it must be clear that the goals generated in this manner at each level — regional, jurisdictional or subarea — are normally multidimensional, because.

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[52] Edwin Thomas and Joseph Schofer, *op. cit.*

[53] Hitch and McKean, *The Economics of Defense in a Nuclear Age* (Harvard University Press, Cambridge, 1960).

[54] March and Simon, *Organizations* (Wiley, New York, 1958).

- Compression of incommensurables reduces the information content;
- Multiple goals are often used as an approximation for a single "real" goal that cannot be measured in practice; and
- Multiple goals are often generated as a means of coping with interactions among different areas in the same level in the hierarchy.

A final point often made is that goal identification is not concerned with ultimate values, but with *proximate* values on which people who disagree on ultimate values can often agree.

In summary terms, the role of this process of scanning the region for issues and goals is not only to provide a point of entry into the planning continuum but also to provide a basis for testing the acceptability of proposed plans. It is designed to assure that issues are formulated and plan solutions developed with constant references to the totality of requirements, values, and constraints imposed by the regional and larger environment. Further, it is addressed to the requirement that land use and transportation prognoses over the planning period be formalized, made explicit, communicable, and hence subject to criticism and reappraisal. In this process, it may help identify goal conflicts and institutional constraints. At the end of this task, a set of goals relevant to the land use and transportation study and recognized on a functional basis will emerge. A set of tentative criteria reflecting the requirements imposed by the selected goal set may also be developed to be helpful in the evaluation phase.

Plan or Policy Design

This phase is concerned with the development of alternative plans or future end states and the policies that are suggested by the goal set chosen. The goal set may suggest a variety of desirable attributes which may conflict or be available at excessive costs (broadly conceived). Thus, as Harris points out, all locators in a metropolis cannot be given space, choice, and convenience — surely not at acceptable levels of cost and safety. Some balance is struck on the assumption that in principle one can manipulate the balance of these desired goals in alternative ways by postulating various levels of density of residential development and the location of employment.

Alternative sets of general policies and regional development patterns are prepared in conjunction with the goal statement. Such a review must be posed in a context that helps the sketch planning process, which may be defined as the preparation in a preliminary fashion of a number of alternative plans at an appropriate level of detail. The preparation of these alternatives permits the planning staff to explore the possibilities in the situation, set forth new ideas, and devise a basis for comparison among plans. Such imaginative views are often qualified by the awareness of the significant stability and conservatism inherent in current policies and development patterns. The ability to innovate

is often thus in a narrow planning range. The recognition of this leverage for planned action is an essential preamble to the development of alternative plans.

In the light of the overall goals, a range of policies, form concepts, interaction concepts, and structural relationships that may be implied in the goal sets and the devised end-state spatial patterns are generated. It is easy to imagine that the resulting combinations of policies, form concepts and interaction arrangements can be a very large number. Care must be taken to assure that a few sets that include a wide range of possibilities which in terms of generic capability merit incorporation in plans be developed. A few preliminary analytical procedures must be employed to array and screen major combinations of policies, form concepts, etc. Such procedures related to performance aspects of physical environment may be relatively simple in concept but yet can be a useful adjunct to the combinational problem referred to above. It is in this manner that plan design and evaluations are highly interconnected.

The identification of each lever or control variable that can respond to public policy is therefore of strategic importance for goal achievement. This aspect of policy design can be illustrated in the context of a public investment program addressed to the economic development of an urban region.

In such a context, one must emphasize the importance of identifying all relevant control variables available to public influence, whether they be attached to the public or private sector of the economy. The first important analytical task is that of classifying public investment activities so as to identify all control variables that are relevant for achieving economic and social development goals, and of defining or classifying public investment activities in terms of these control variables. The significance of this type of classification scheme is that it relates existing public investment alternatives directly to their role in influencing the economy toward goal achievement in the same terms that may be employed in the analytic framework. In addition, it would suggest areas of public activity for which policies have been inadequately addressed.

A preliminary set of control variables into which public projects and programs may be classified include:

A. Indirect Controls (goal achievement through private sectors)

1. Primary resource development: (a) land orientation (including natural resources), (b) labor orientation (manpower development), (c) capital supply, and (d) entrepreneurship.

2. Social overhead capital (a) water supply, (b) power orientation (*i.e.*, electrification), (c) transportation, (d) education, and (e) communication

3. Amenity orientation: (a) park and recreational development, (b) residential investments, (c) cultural development, and (d) pollution reduction.

4. Urbanization and localization economies (market-orientation and growth pole effects). (a) sewage treatment and disposal, (b) health facilities, (c) industrial complex development (industrial state), and (d) mass transit.

B. Direct Control

1. Expenditure impacts (*i.e.*, government purchasing).
2. Employment in public works projects.
3. Employment in local, state, and Federal government.

The public policy instruments listed under Indirect Controls essentially affect performance variables, such as per capita income in a particular area in a specific time period, by upgrading internal and external locational advantages with respect to some specific industrial sector or population class for the purpose of effecting private capital or human investment in that region. On the other hand, direct controls affect performance variables with full control (*e.g.*, unemployment in an area is reduced through jobs created in a water resource development project). Both types of controls, however, further indirectly impact goals through various economic and social relationships.

The metropolitan plan incorporating many dimensions of physical, economic, and social development goals definitely offers a broader and more complex set of control variables than presented above. Thus, this list of control variables must be viewed as illustrative. However, it does represent many types of alternative opportunities that exist for the application of urban and regional public investments in attaining a variety of development goals.

Finally, the preparation of candidate plans that incorporate the results of all previous work is carried out. Such plans express in cartographic form land uses — their types, densities and disposition— transportation facilities, natural features and form concepts. These plans are the alternatives for testing through the models

In summary, the process of plan design consists of specifying various decision, or control variables (or policies) addressed to the planning objectives in the estimation phase and their expressions in plans. Independence obviously does not exist among all the variables and relationships that could be used to describe a plan. The choice of some variables as decision variables is somewhat arbitrary and depends to a considerable extent on the planner's view of the goal structure and ease of expression. In this judgment, the planner is considerably influenced by the outcome or impact measures to which we turn next, and the criteria used in the evaluation phase.

Estimation of Impacts of Alternate Control Variables

The impact estimation phase involves essentially the development of functional relationships between control or policy variables and the impact or effect variables identified as crucial to plan selection.

To identify the scope of this phase, one can begin by considering what information would be desired in an infinitely informed analytical climate. The fundamental dependent variable is, ideally, not only the magnitude of each type of effect but also the distribution of such overall magnitudes with respect to several important dimensions of incidence stratification: the time period, areal unit, and economic sector or population group which occasions any given

effect. This broadly defined dependent variable is influenced by the fundamental characteristics of each hypothesized policy or project and the particular combination of such projects. The fundamental characteristics of any given project include its magnitude, project type, the time period of implementation, and its geographic location. The consequent effect depends upon the location characteristics of the respective areas in which each benefit type is occasioned. An ideal analysis of effect would trace the influences of such a complete characterization of projects and the local characteristics of the incident area(s), including interdependence effects between areal units and between projects.

For the sake of convenient exposition, it is helpful to cast this impacts problem into mathematical language. Assuming that all impacts of a set of public investment projects can be determined in reference to the project as a fundamental analytical unit, there are two distinct types of effects which must be considered. Some projects are mutually exclusive, while others entail joint effects. Accordingly, all relevant information about the effects accruing from any proposed set of projects, together with any hypothesized schedule for implementing any such projects over time, can be summarized by the following two descriptors:

$A^{r}_{g,\,s,\,j}(t_k)$ = the magnitude of effort type r accruing during time period s incident upon population group j (or, alternatively, upon industrial sector i) in areal unit g, associated with the implementation of project k during time period t_k (for all g, j, r, s, and k)

$B^{r}_{g,\,s,\,j}(t_k,\,t_l)$ = the incremental magnitude of effect type r occurring during time period s incident upon population group j (or industrial sector i) in areal unit g, associated with the joint implementation of both project k during time period t_k and project l during time period t_l (for all g, j, r, s, k and l)[55]

The parenthetical notation is employed to depict the three descriptors as a function of the choice variables t_k *and* t_l. Given such a complete description of each project's potential effects the general evaluation problem is to describe which specific projects should be implemented and how they should be staged over time. This problem is tantamount to choosing values for the t_k and t_l which are, in at least a crude sense, optimal or at least preferred over the range of projects considered.[56]

[55] Inherent to this conceptualization of the "joint" descriptor is the assumption that third-order effects (second-order interproject externalities) are negligible. This involves questions of project complementarity below

[56] We have already seen that much planning is of the "feasibility" or "satisficing," rather than the optimizing variety. J. W. Dyckman cites Herbert Simon's views as most descriptive of long-range social planning methods in "Planning and Decision Theory," *Journal of the American Institute of Planners*, XXVII (November, 1961), p. 339. Dyckman cites as reasons the difficulty of formulating objective functions, the difficulty of mathematically optimizing one, even if it exists, and the large cost (in time or money)—even if one *could* achieve a solution.

Given these descriptors of effects, it is further necessary to establish the cause-effect functional relationships by which the effects descriptors depend upon individual projects' characteristics, the combination of projects, and local characteristics.

$I^k_{h,\ t_k}$ = the magnitude of investment prescribed for project type k in areal unit h, implemented during time period t_k

$X^r_{g,\ s}$ = the magnitude of local characteristics type r in areal unit g at time period s.

Given these definitions, two types of functional relationships are of interest, expressed as f and g in the following mathematical statements:

$$A^r_{g,\ s,\ j(t_k)} = f(I^k_{h,\ t_k}, X^r_{g,\ s-l})$$
$$B^r_{g,\ s,\ j(t_k,\ t_l)} = g(I^k_{h,\ t_k}, X^r_{g,\ s-l})$$

Note that, as the notation implies, effects may be defined as temporal increments or decrements in the local characteristics variable.

Utilizing the Impact Vectors' Transformation to Preference Vectors

The difficulties of transforming impact vectors to explicit preference vectors should not prevent the metropolitan planning agencies from attempting this task in one way or another. A decision must be made, and, while that decision is the responsibility of policy-makers, the planning effort must assist that decision-making process to the extent possible.

The first point to be realized in this context is that this sort of public investment decision has been made many times in the past. That is, various types of effects for which no obvious value exists in fact have had weights attached to them, although they are entirely subjective weights implicit to the thought processes of policy-makers.[57] Whether these decisions have been correct cannot be determined by any means; value judgments of policy-makers represent the final word. On the other hand, there may be legitimate cause to question whether those decisions have been made or even can be made by sounder methods. More to the point, the planning effort must address the question: given the communication of all relevant consequence information, how might the planner assist the policy-maker insofar as the latter's comprehension and comparison of these consequences are concerned?

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[57] This observation requires some qualification since practically all of the decision processes in which such "weights" have been attached have involved only a few effect variables, often times only two (efficiency and income distribution). On the other hand, it may be argued that, whether or not a policy-maker has dealt with only a few variables for which explicit information has been quoted, the question of what other (unmeasured) effects he *perceives* is purely speculative.

It is most convenient to approach this matter in reference to a general abstraction of the decision-making process, which is borrowed from Holt. [58]

> Any brief summary of the process by which the President, the Congress, and the electorate of the United States reach decisions on national economic policy is necessarily a crude caricature. Nevertheless, if we are to discuss some of the basic elements in the process, some such simplified picture as the following is needed: first, a problem is recognized which requires attention; second, alternative courses of action are formulated; third the outcome associated with each of the alternatives is predicted; fourth, the outcomes are evaluated to determine their relative desirabilities; fifth, a choice is made in the context of conflicting political and constituency interests. The actual process is, of course, a complicated successive approximation procedure: for example, one of the political choices may be to redefine the problem—thereby starting the whole process from the beginning again.

The concern here, of course, is with the last two elements of the decision process. Implicit to those elements is the formulation of a criterion function and the assignment of a weight to each outcome type, by each policy-maker individually in the first instance. The point to be realized here is that decisions on social investment, by the very fact that they are made, implicitly involve benefit calculations and therefore weights.

The discussion is of course extremely academic, but serves as a convenient point of departure as well, making the problem more explicit: how might the planner assist the policy-maker in assigning relative weights to effect variables? This is perhaps the most difficult aspect of the entire evaluation process, arousing considerable debate.

One finds many endorsements in the literature of both extremes of this debate, as well as the less staunch positions. A variety of intellectually appealing but mostly untried techniques for estimating relative weights for multiple-objective decision situations have been advanced, hypothesizing that the preference functions of policy-makers can be identified in objective terms through opportunistic interrogation.[59] Others argue that utility, by its very definition, cannot be measured, but that these methods attempt to do so. Still others suggest that, while utility-conversion factors are too nebulous to probe, it is sensible to pursue, where possible, the development of dollar conversion factors. The use of rating schemes for evaluating preferences has also been a rapidly developing technique, including the important consideration that indi-

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[58] C. C. Holt, "Quantitative Decision Analysis and National Policy How Can We Bridge the Gap?" *Quantitative Planning of Economic Policy*, ed. B. G. Hickman (The Brookings Institution, Washington, D.C., 1965), p 253.

[59] Q. McNemar, "Opinion-Attitude Methodology," *Psychological Bulletin*, 43 (July 1946), pp. 289-374, J. Von Neumann, and O Morgenstern, *Theory of Games and Economic Behavior* (Princeton University Press, 1953); P. C. Fish-

vidual factors on which the items are being assessed interact in producing an overall result.[60]

From the bare fact that a decision is made by a policy-maker, it is incontestable that, through the intricate workings of his mind he is implicitly not only attaching weights to each outcome type or effect variable but also reducing these incommensurate variables to some common unit. Moreover, the nature of his criterion function is also incontestable: he is maximizing these units in a manner which is similar to the algebraic sum, over all effect variables including capital costs of the units which he attributes to each effect, be it positive or negative.

This criterion is not different from the maximization of a welfare function or, if referenced to the existing situation and thereby formulated in terms of temporal changes in effect variables rather than end-states *per se,* the maximization of consumer's surplus. Benefit-cost analysis, economic efficiency, and general equilibrium analysis, have been employed in evaluation efforts referring to tangible and valuable effects.[61] In reality, these techniques differ only in the types of effect variables they deal with. The policy-maker's criterion, even if an extremely implicit one, is no different in concept from these techniques. The weights are merely hypothetical prices, and the criterion represents a sum of individual price-quantity calculations.[62] This is true, also, for non-market effects, by reference to observed phenomenological trade-offs between such effects and some other effect for which a market exists.

It is hardly necessary to point out that, in view of the variety of effect variables defined as relevant, metropolitan planners cannot feasibly present to policy-makers one aggregate number for each system modification alternative. They would in all probability reject the concept, particularly if interaction between planners and decision-makers were concentrated toward the end of a study. It is far less easy, however, to dismiss entirely the idea of applying on a test basis one or more of the available scaling techniques to a subset of effect variables. As Holt argues, such a trial may be justified on the basis of sound

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burn, "Evaluation of Multiple-Criteria Alternatives Using Additive Utility Measures," Research Analysis Corporation, published as AD 633 595, U.S. Department of Commerce, National Bureau of Standards (Washington, March 1966); Marshall Freimer and Leonard S. Singer, "The Evaluation of Potential New Product Alternatives," *Management Science,* 13 (February 1967)

[60] Discriminant analysis and Bayesian theory have been applied here. See Freimer and Singer, *ibid,* also, Herbert Terry, "Comparative Evaluation of Performance Using Multiple Criteria," *Management Science,* 10 (April 1963); also Philip Kitler, "Competitive Strategies for New Product Marketing Over the Life Cycle," *Management Science,* 11 (December 1965).

[61] H. W. Bruck, S. H Putman, and W. A Steger, "Evaluation of Alternative Transportation Proposals. The Northeast Corridor," *op. cit*

[62] K. J. Arrow, "Criteria for Social Investment," *Water Resources Research,* Vol. I, (1965), p. 4.

forecasting.[63] To the extent that metropolitan plan evaluation involves the role of testing untried planning methodology which might lead to significant payoffs in the future, it should seriously consider testing such valuation techniques, at least on a group of planners and other professionals, if not on policy-makers themselves.

Holt's argument might be extended along still another dimension. One of the strongest sources of skepticism toward employing such techniques refers to the transitivity requirement common to all of these methods.[64] That is, the claim of some skeptics is that policy-makers may not exhibit transitivity when subject to such methods, particularly if many effect variables are included. Indeed, this may well be the case, even if only a few variables are included. The implication of such a result, of course, would be that perhaps many public policy decisons made in the past on a purely subjective basis have also been characterized by intransitivity. Were this the case, the immediate failure of a valuation technique in itself offers justification for continued use of such techniques to help improve future decisions, even if they remain subjective, merely by helping policy-makers to be aware of the transitivity problem.

In the final analysis, whether to try such techniques rests upon the extent to which policy-makers deem it worthwhile to participate in such a trial endeavor. If nothing else, the observations of the last few paragraphs emphasize the mutual benefits to be derived from relatively continuous interaction between planners and policy-makers.

There are several alternatives to such scaling techniques, none of which is claimed to come any closer to solving the evaluation problem *in toto* but all of which may be more practical. The most pessimistic approach, though not necessarily an unwise one, derives from the extreme point of view that so many effect variables must be dealt with in a real world decision that it is impossible to attach explicit weights to all of them Furthermore, the argument proceeds to conclude that, since only a few variables can be weighted in dollar terms and even these must be converted to some units of psychological value for a decision (subjective or objective) to be made, any effort to measure weights for any variables is ridiculous. This alternative, then, favors the stratgey of leaving everything up to the policy makers. Assistance could be offered, in a limited sense, by a cogent taxonomical design.

A more reasonable approach has been at least to attempt to clarify to policy-makers the phenomenological as opposed to the psychological trade-offs between selected effect variables. The modeling systems purport to be capable of representing the real world, within the limitations of available data. A limited but well-designed sensitivity analysis of this modeling system portrays at least, in a crude fashion, the substitution or complementarity relationships between

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[63] C. C. Holt, *op. cit.*, pp. 255-256

[64] By example, transitivity exists if a subject prefers A over C given that he has independently claimed to prefer A over B and B over C

selected effect variables without attempting to attach any sort of price to such variables.

Finally, some effort has been directed to examining in depth the trade-offs between selected non-market effect variables and one or more variables for which a market not only exists but indicates dollar value reliably. This approach derives from the point of view that, to the extent possible, all effects which can be expressed in dollar terms should be measured and summed as well as being identified separately. The valuation of travel time savings has been pursued along these lines with some success, and other variables might be amenable to analysis Such in-depth exploration of trade-offs are distinguished from the suggestion of the previous paragraph not only because a monetary valuation or price is involved, but more importantly because such research must concentrate on situations where only two variables — the non-market variable being priced and the market variable referred to as an indicator—vary significantly, so that all other variables are held constant or nearly so. In general, such explorations will at best reveal upper and lower bounds, but such information would be well worth any reasonably proportionate effort.

STATE-OF-THE-ART GAPS IN EVALUATION METHODOLOGY: DECISION-MAKING REQUIREMENTS AND THE ANALYTIC CAPABILITY TO MEET THESE REQUIREMENTS

We have attempted to describe a relatively complete spectrum of planning and decision-making requirements and to weigh against these the potential capabilities of analytic methods to meet these requirements.

Unfortunately, while substantial gaps appear to exist, it is difficult to estimate how important these are (or could be)to successful and improved decision-making. No one has yet developed adequate measures of the outputs of planning and decision-making. No substantial set of analytic, empirical case studies of cost effectiveness of planning and decision-making—with and without alternative planning and decision-making resources and operations—has been made Therefore, these evaluation gaps should be interpreted more as requirements than as an unambiguous preferred or optimal set.

The following factors, at least, are important in the evaluation of plans which are generated by the metropolitan planning process.

- Issue Space Under Review. Has a comprehensive range of issues been posed? Or is there just the traditional focus on spatial aspects of phenomena? Are the aspatial—normative and functional organizational—aspects of metropolitan issues under consideration?

- Scope of the Decision Process. To what extent are the goals and functions considered capable of incorporating the salient features of the metropolis and the decision-making process? To

what extent do the plan design and evaluation phases capture the essentials of the decision-processes of planning?

- Range of Alternatives. Is there an inclusive set of alternatives? Or is there really a basic alternative and a bunch of "straw men"? To what extent is alternative design influenced by the evaluation methodology?
- Impact Groups and Incidence Dimensions. Have the plans identified the social and economic groups to be impacted by them and the magnitude and dimensions of incidence to facilitate the evaluation process in terms of preset goals and benefit groups?
- Evaluation Framework. What is the framework of evaluation methodology? To what extent are the decision process, the concern for impact incidence, the preference structures of the populace, and other issues reflected in the methodology selected? How adequate is the informational base for the evaluation methodology selected? [65]

This list is quite clearly illustrative However, it is indicative of the set of criteria that could be used in evaluating the plans generated in metropolitan planning. In any case, these criteria have been used to structure the discussion of the gaps that follows next.

While both the planner and analytic technician talk of global assistance to decision-makers, their resource limitations, biases, and technology have caused them, by and large, to ignore much of the issues' space in urban and regional matters. When metropolitan planners seek to guide physical development, it is really the spatial organization of activities and use that is the focus of concern. Such a view ignores a whole range of aspatial issues relating to community values and functional organization that can be considered without regard for spatial arrangement. If the planners' issue space enlarges to include both the spatial and aspatial urban issues, he will be encouraged to take into account the ways in which the physical environment he recommends facilitates or impedes various activity systems that are accommodated by environment.[66]

Further, with few exceptions, the planners have left the two major issues of the preferred public role for urban functions, and the incidence (redistribution

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[65] Some key factors in the evaluation of the planning process (not detailed here) are (a) the comprehensiveness or scope of the approach, (b) view of the planning process, (c) organizational structure of the process, (d) impact estimation techniques, and (e) relevance of evaluative criteria

[66] Donald L. Foley, "An Approach to Metropolitan Spatial Structure," in M. M. Webber, *et al.*, *Explorations into Urban Structure* (University of Pennsylvania Press, 1964).

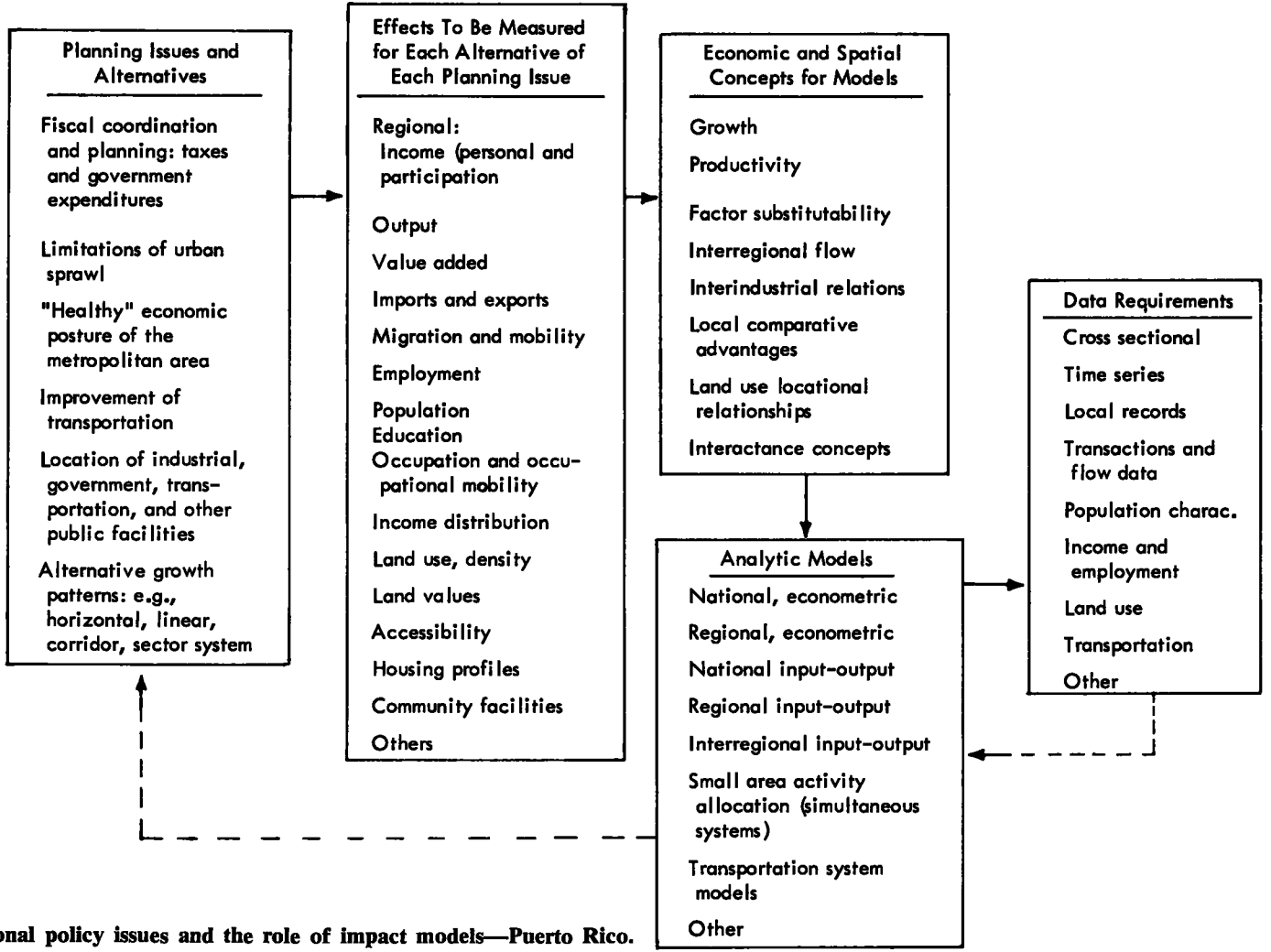

Figure 3. Regional policy issues and the role of impact models—Puerto Rico.

consequences) of alternatives, almost exclusively to more aggregate echelons and/or the political sector. This is unfortunate, because their role places them in an excellent position for defining urban and regional functions, for sensing (and thus measuring and communicating) externalities and scale economies. Furthermore, the technologies for attacking these problem areas are no less available than those for the issues with which we primarily do concern ourselves.

While this decade has been described as the golden age of decision-making studies,[67] there have been very few studies identifying the changing goal structures, the planning issues, the alternatives examined, the impact measures, and the evaluative methods.[68] One study has described the heuristics of budget decision-making in the cities of Detroit, Cleveland and Pittsburgh, and has utilized the results of the simulation for partially successful "forecasting" of these decisions.[69] Improved studies for systematically capturing the decision-making processes of planning are required, before normative models can be designed. Too much is being assumed today about the planner's information availability and processing requirements. Even acknowledging the likely changes analytic methods should make to and for the process, much of the current process will remain relatively undisturbed, and, thus, should be better understood. Operationally, this requires a more explicit understanding and explication of planning processes.

Impact Modeling Strategy

The overall strategy of impact modeling is arrived at—and should be, for each study by trade-offs between: the diversity of impact types to be estimated; the dimensions of impact incidence—areal, sectoral, population class, and temporal; the state of the art of analytical techniques; and the richness of the informational base Other papers in the Conference are addressed to an articulation of the difficult choices in this process. The scope of our discussion is limited to one aspect—the geographic hierarchy issue—of impact estimation. It illustrates an impact estimation strategy—the "top down" approach—found convenient in expressing location, comparative advantage and growth consequences of public policies at different geographical levels.

Figure 3 is an attempt to relate an illustrative set of policy issues to the process dimensions of which alternative planning programs are composed. Alternative planning issues of major importance are indicated on the left side of Figure 3; the effect types, which are the consequences of the alternative choices, and then, classes of relevant economic and spatial concepts are

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[67] Kent Mathewson, "Planning and Decision-Making in the Detroit Metropolitan Area," Highway Research Record, No 137, 1966, p. 14

[68] A. Altshuler, *The City Planning Process. A Political Analysis.* Cornell University Press, 1965, is an excellent case study of the planning process. Another is Frieden, *op. cit.*

[69] J. P. Crecine, doctoral dissertation, Carnegie Institute of Technology, 1966

shown, ranging from growth considerations to local comparative advantage concepts; next, various types of models are indicated; and, finally, the alternative data requirements for the concepts and the models are broadly indicated, with the feedback to models resulting from the feasibility and cost of the data-model system, combined.

The purpose underlying the general sequence of effect estimation in the illustrative case of Puerto Rico (Fig 3) is quite simple: to be able to estimate the consequences of impacts in terms of income, output, population and its characteristics, employment, land use of alternate policies addressed to the crucial planning issues at different geographical levels, nation, region, metropolitan area, and subareas in an urban area. As alternative policies are forged in response to planning issues and goals, mathematical models are used to make conditional forecasts, for example, if a particular land use growth policy or tax policy is envisaged, what growth or distribution consequences might occur?

The development of quantitative forecasting methods addressed to such sets of impact measures can be attempted through a theoretical framework embracing regional economic theory, comparative advantage, and location theory. No single analytical method, however, is likely to accomplish the forecasting requirements for evaluation of urban/regional public investments The various analytical models, furthermore, would have to rest heavily on empirical bases that attempt to capture most of the changing patterns of economic and social growth in response to public investments.

Comparison of alternative sets of procedures strongly indicates that impacts best can be arrived at by a series of successively finer geographical approximations. For example, first, what changes might occur at the level of the region which is most open to the outside world; then, the various subregional levels (metropolitan, urban, etc), and, finally, individual subareas within an urban area?

This type of framework of a multilevel impact estimation is envisaged in view of the different forces, in fine detail, that appear to operate at these different levels. Various modeling schemes may be devised so that the results of the immediately broader (geographically) scale model can constrain the solutions at the next level The multimodel "top down" approach can produce a maximum amount of valid information. It can serve as a very necessary and valuable link between the economic planning at the regional level and the physical planning at urban and subarea levels

The choice of modeling schema appropriate to this approach is a function of the potential benefits, tied to all the uses to which the modeling outputs would be put, and the total cost of producing these: the data, manpower requirements, computers, etc.

Needed Improvements for Evaluation

Aside from the obvious benefits for conditional forecasting methods, better

understanding of underlying present and future preference patterns of individuals and client groups is also fundamental for evaluation. The methods of classifying and reducing effects categories, of choosing effects to forecast, and for weighting effects classes—these can no longer fall back on impractical schemes for measuring consumer surplus.[70] The translation of effects vectors into preference vectors strains the confines of traditional cost-benefit frameworks, or, for that matter, even the most sophisticated general equilibrium framework.[71]

More attention will have to be paid to other routes for assessing preference functions:

- to the historian, architect, ecologist and anthropologist, for what articulate human beings have said, and say, about the quality of their environment,
- to sociologists for the application of content analysis;
- to opinion pollsters for what people claim they want, directly;
- to the econometrician and statistician for measuring what has and is actually chosen by consumers;
- to the social scientist for descriptive and normative models of consumer behavior;
- to the social psychologist, for structural and constrained methods for conducting interviews,
- to system analysts, for structured experimental situations;
- to the political scientist and statistician, for intensive analysis of voting behavior, and for methods to simulate voting behavior; and,
- to public administrators, for improved ways to ascertain the trade-offs between effects measures desired by community leadership.

Operationally, within existing regional planning studies, this would call for intensive review and use of home interview techniques, and the enlarging of the view as to which resources might be helpful in ascertaining present and future preferences and future preference functions.

[70] M Ahmed, "The Development of the Concept of Consumers' Surplus in Economic Theory and Policy," *Indian Economic Journal*, 13 (April-June 1966); P M. Gutmann, "Neoclassical Utility and Inter-temporal Consumer Decisions," *Economia Internazionale*, August 1966

[71] For a summary and comparison of these many methods used in evaluating transportation and land use systems, see Bruck, Putman and Steger, "Evaluation of Alternative Transportation Proposals The Northeast Corridor," *op cit*, pp. 330-333.

Operational measures of the output of urban areas and regions; *i.e*, the contribution of the metropolitan environment to the public welfare are also, ultimately, required. Much can be said about the need to improve the social infrastructure so as to maximize human potential through increased access to opportunities of all varieties. But what actually do agglomerated environments add to social and economic productivity? Without a fuller description of the functions of agglomeration, and an appreciation of the preferences toward the products of these functions, we can never achieve these output measures. And without an agreed-upon set of output measures, we never really fully can achieve rational resource allocation to the policy issues of regional and urban public investments, let alone to planning for these Clearly, this is a high-order need, similar in importance to a rekindling of interest in land, *i e.,* spatial allocation as a factor of production, commensurate in importance to labor and capital.

Without dwelling at length on any of these topics, each of which itself would deserve its own paper, experience with developing planning models has convinced us that the following improvements are required.

- More emphasis on total system costing of projects and programs;
- More use of games and man-machine simulations, not just for pedagogical purposes, but for the development of alternatives for testing, and "goal-goal" trade-off functions;
- More intensive use of case studies of the effects of public investments, if the data collection schemes can be made appropriate to the detection of the system effects;
- More explicit attention paid to the communications and mutual education relationships between analyst and planner,[72]
- More advance attention paid to the relationship between analytic outputs and specific design needs of the planners;[73]
- Better definition and mutual acceptance of definitions of analytic validity, including specification of validation criteria;[74] and,
- More attention paid to the incidence of effects.

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[72] W. A. Steger, "Review of Analytic Techniques for the CRP," *op cit.,* pp 170-171; N. Grundstein, "Urban Information Systems," *op cit.*

[73] The Bureau of Public Roads and the Department of Housing and Urban Development are both supporting research in this important area, currently.

[74] Charles F. Hermann defines several kinds of model-building validation including· internal validity. face validity; variable-parameter validity, event validity, and hypothesis validity. See "Validation Problems in Games and Simulations with Special Reference to Models of International Politics," *Behavioral Science,* 12 (May 1967), pp. 220-224

New technology users—and model-builders are no exception—frequently begin to construct their second generation models before they are prepared to analyze the value of their first generation efforts Given the availability of resources this may be desirable; the second generation work can serve as beneficial incentive feedbacks upon the first-generation work, given proper communications between them This work is proceeding, and should proceed, along several points:

- Improved capabilities to link models at different areal and functional hierarchies, to use and automatically revise control totals, so as to efficiently exhaust a total information space;[75]
- Better methods for utilizing comprehensive problem solving models for smaller problems, or for building on smaller problem solving models to fit better into a larger scheme (*i.e.*, the global versus piecemeal approaches);
- Better explicit strategic and tactical planning in the use of all systems research techniques, including the types of trade-offs between technique attributes and techniques;
- Improved measures of externalities and social costs as outputs of analytic methods,
- Explicit incorporation within urban and regional models of "states of the system," described through historical stages of growth,[76] or in terms of decision-making capabilities;[77] and,
- More explicit incorporation of the structure of behavior and decision-making, even if this requires new combinations of heuristic and normative submodels within a larger framework.

Concluding Remarks

We have attempted to describe public sector decision-making needs in such

[75] Some people refer to this as a "top-down versus bottoms-up" problem: can urban areas make choices so efficiently that macro-income and wealth totals should be formed by summing regional data rather than allocating macro totals to regions?

[76] Eric E Lampard, "American Historians and the Study of Urbanization," *American Historical Review*, 66 (October 1961), Ray Lubove, "The Urbanization Process· An Approach to Historical Research," *Journal of the American Institute of Planners*, XXXIII (January 1967), Sam Bass Warner, Jr., "If All the World Were Philadelphia: A Framework for Urban History, 1774-1930," Institute for Urban and Regional Studies, Washington University, Working Paper INS #1, 1967.

[77] Nathan D. Grundstein, "Some Conceptual Problems in the Simulation of Public Social Systems," *Selected Papers in Operational Gaming*, ed Allen G Feldt, pp. 51-53.

a way that gaps could be revealed between requirements and the capabilities of analysts to meet these needs. We have not attempted to quantify these gaps, or even to arrange them in some priority order

To some extent, the problem is similar to trying to arrange for priorities within basic research by linking this research to all potential uses. To a larger extent, however, it is more similar to managing resource allocation for applied research and science programs Here, the basic urban and regional issues of the future would be arrayed in some order of importance and the feasible contribution, at the margin, of decision-aiding techniques would be related to each of these issues and the informational needs represented by these issues.

Nobody, apparently, can yet do the long-term priority ordering which would be needed to accomplish this management task. Until that time, our resource allocations will be based on more pragmatic grounds—near-in supply aspects, more vocal demanders, and non-military budgets.

At the very least, a better record of what is happening in this field, as well as a more uniformly accepted set of definitions—and perhaps, criteria—is needed.

COMMENTS

LYLE C. FITCH, *President, Institute of Public Administration*

Not having obtained a copy of the paper before arriving, I am constrained to generalizations. First, I shall comment on problems of uncertainty in planning and in model building, and raise questions about accommodating models to uncertainty, particularly in this age where things are changing rather more rapidly than they have ever changed before, except in brief cataclysmic periods. We have become more accustomed to change than we have to stability So I would like to raise a question as to how change affects planning.

The concept of "planning" implies at least a reasonable degree of certainty If you propose to go on a trip you lay out your razor and your toothbrush, and you make "plans" with a conviction that a high percentage of the things you have "planned for" will happen. But is this really planning? I would argue that it is not. Laying out the razor and toothbrush is more properly described, not as planning, but mere preparation making. Planning really in this day and age is concerned with uncertainty, and the essence of planning is coping with, and inventing ways of handling, uncertainty.

There are many kinds of uncertainty, of course. One of the great uncertainties we all face is the uncertainty of data. In this connection I was struck by Alonso's paper (see Part III) which illustrates how data uncertainties cumulate. Thus, you may start with a sequence of 80 percent probabilities and find that the probability of the fourth event in the sequence is only about 40 percent.

Second, I am concerned about the license with which poor numbers, originally constructed or assumed for some specific purpose, are used and misused

once they get into public domain. They may get bruited about, appearing in all kinds of policy decisions and other inappropriate contexts. Numbers being inherently mischievous, data uncertainties encountered in model building can perpetrate all kinds of new mischief. The danger is more serious in that so much of our social science model building requires contrived data, and surrogates of various kinds (*e.g.*, an index of violence, or poverty, or government output).

The above, now that I think about it, is no more than a restatement of the garbage-in ——→ garbage-out principle. A more inherently serious challenge to social science model building is posed by the school which argues that the social order is inherently so complex as to defy systematic planning and which argues that the best one can do is to plan for very incremental change in a very partial kind of way, for short periods, and for unrelated kinds of decisions, in part because change itself is a process of "disjointed incrementalism." One trouble with this thesis, the Lindblom-Braybrooke thesis, is that the world is full of changes which are more than incremental. But the basic question is whether the world of affairs is in fact as disjointed and unsystematic as the thesis asserts, or whether some things are so systematically hooked together in systems as to make the use of models fruitful. Agreeing with Britton Harris that every policy-maker, even those who rely on divination or serendipity, has some kind of model, at least an implicit one, in his subconscious, I would argue for the systematic modeling approach. (I must admit to having been a bit shaken by Lowry's paper, however.)

I am also concerned about the vulnerability to uncertainty of models which seek to optimize or maximize something. Herbert Simon's concept of "satisficing" is one approach to coping with this kind of uncertainty. There are numerous other ways of handling uncertainty, which we have been exploring at the Institute of Public Administration. One means of reducing uncertainty is improving data. Another familiar technique is that of making projections which put reasonable limits on uncertain magnitudes. Thus one might place the average growth rate of the Gross National Product over the next 33 years between 3 percent and 4 percent, reject 2 percent as being unreasonably low and 5 percent as being unreasonably high, and take a range between 3 and 4. (Incidentally, that makes quite a difference. In 33 years there will be a difference of $9 trillion between a 3 percent and a 4 percent growth rate in Gross National Product.)

Another technique, of course, is to choose carefully among the alternatives for analysis. Choosing lines of action that preserve flexibility is a highly important means of reducing uncertainty. Consider the question of whether to take over certain unused New York piers for such other purposes as building apartment houses on the sites Certain unnamed planners have said we should have an econometric model of the regional development in this area in order to determine whether those piers someday will be needed—in which case it would be awkward if they had been converted into apartment houses. In this

case, I assert that more analysis would have indicated ways of retaining flexibility. Piers are not that difficult to build, and there is no reason why they all must be located on either the east or west side of Manhattan. Again, one may reduce uncertainty by hedging and by grouping future events to take advantage of probabilities instead of staking everything on the outcome of a single venture, or single event. For example, it would be better for a municipality or a region with foreseeable land needs to acquire land for a number of future needs, as part of an integrated plan to minimize risk, than to consider and handle individual needs separately. In the latter, the decision-maker may risk his neck on too narrow an outcome—a kind of risk, incidentally, that politicians always shun.

Finally, we must consider the question of formulating social goals that can serve as broad policy guidelines and which, in so doing, themselves tend to reduce uncertainty, a topic of the Steger-Lakshmanan paper. Where do the model-builders' goals come from? Fundamentally, America still exhibits attitudes of a free enterprise society and American values are predominantly middle-class. The middle-class looks at the market to satisfy most of its wants, and it still does not recognize very clearly the legitimacy of the public process We do not usually think of public policy constructively, but rather as a means of removing irritations, like congestion and pollution It never occurs to most people to plan against any of these things until after they occur. And the reason is, of course, that as a society we are not accustomed to thinking in such a social idiom. This lack of instinct is fortified by the economists who tell us that a social decision usually is inferior to counterpart market decisions because a social decision leaves a number of people unsatisfied, with more or less of the social good than they would prefer.

But this line of reasoning, I submit, reflects one of the weaknesses of contemporary economic theory—the weakness of assuming that preference scales are stable and determinate. In fact, preference scales, particularly in the case of social decisions tend to be formed by interaction between the household and the individual on one hand, and the social process or society on the other. We have all had the experience of seeing people fight against community policies or improvements which, after adoption, they would not think of changing The substitute for the market process in the social sphere is the goal-making process. Goal formulation and the building of public consensus around goals is the most important role of political leadership. In the process, I still have faith that the emerging techniques of model-building can give greater force of rationality, however defined. Having alluded to the question of rationality, however, I hasten to leave the field to other discussants.

CHARLES GRAVES, *Department of Housing and Urban Development*

I would like to make a few comments on the gaps that Mr. Steger spoke about. One of the gaps is the issue space, and I think he is on the right track with the questions about who builds systems, who pays for them, and who

gets special benefits. I think these are the kinds of questions asked by members of Councils of Governments or by advisors to metropolitan decision-makers. They do ask how much is this system going to cost and how many ordinary people are going to use it on the average day; and they also ask a lot of other questions—do I have to pay for it, or does somebody else pay for it? Is it going to hurt or help the tax base? I know that intellectually these are less than satisfying criteria, but in my short experience I have found that these questions are the ones that people ask. Decision-makers want to know what special benefits and social hurts would happen to particular groups inside the community. In the Department of Housing and Urban Development we are constantly asking how long people benefit from a particular set of recreation investments or transportation investments. Politicians want to know if it is going to cost votes at the next election. Model-builders are not responsible for the answers to most of these questions, and some of them are a little fictitious. But some of them are, I think, the subject for land use distribution models. I was a little disappointed that there were not some illustrations, even if incomplete ones, of how some of these issues might be incorporated into existing models, or some examples of what kind of data or approaches might be used to begin the modeling process

The second thing that struck me about the paper is a subject that Lyle Fitch touched on a good deal. I think he demolished one of the legs of the argument; that is, the incremental forward-looking kind of approach which I think Will Steger has. Lyle Fitch insists on considering the way decision-makers actually do go about making decisions and relates the kind of information planners ought to provide to the needs and limitations of these policy-makers. We in HUD have some sympathy with this approach because we have investments to make in the short run and we just assume that local politicians do too. It does seem that decision-makers are more interested in clearing up existing problems as they see them than working toward the technician's Utopia Their short terms of office almost dictate the short-term approach.

The unused capacity in many systems suggests to me that the change best can be brought about by analyzing existing problems in existing systems. Joe Stowers has said that this method is used in many transportation studies. After they crank up what purports to be a goal testing model, they turn it on the existing plus the committed system, and start zeroing in, as I have heard some engineers say, zeroing in on the final system. But this really is a kind of incremental approach. I do not think that so many planners would use this approach unless practical pressures required it.

However, perhaps I am making a straw argument, because even the goal-oriented people would insist that after analysis one comes back to the next investments that must be made. I would like to hear more comment about this because I do not observe planners doing it in a very explicit way, although good arguments are made in favor of Steger's approach.

There are a number of other gaps listed near the end of the paper. Steger

speaks about a hierarchy of models, and I think that means a larger and smaller set of geographic spaces that the models operate on from the metropolitan to state, regional, and perhaps national level. It scares me a little bit because I do not think we have models operating very well at any of these levels and it is probably premature to talk about hierarchical networks.

Fitch's and Steger's discussions of public preferences open up an important subject. As Fitch has said, there are so many settled trade-offs that it is really politics. The whole political system is terribly complex and we have a whale of a long way to go. On the other hand I think we could all contribute by making objective measures of goals which can double as measures of performance output of the systems. Steger touches this subject in two places. It seems to me that better work can be done describing goals in ways that also will reveal if progress has been made towards the goals. For example, I suspect that crime rates, levels of education, and levels of transportation service are fairly easy to make explicit in a model. I do not know why someone does not say that people are moving around in the built-up portions of our region at 20 miles per hour on an average, and that our goal is to make it 30 miles per hour Then let them do a plan in terms of the minimum investment required to get speeds to 30 miles per hour. Then the planners could measure their achievement in terms of goals that the public understands; I think it would be helpful, too, to the allocators of funds in the Federal Government. If there were large gaps in some metropolitan areas between existing levels of services and what have been established as norms, I think we would be more willing to allocate investments in those areas rather than in others. Presently, the amorphous nature of goal statements discourages any kind of discussion along these lines.

I hope, in this discussion, that I have treated the most pertinent topics. I hope that we will have more discussion of the need to challenge a wide range of issues, to try to answer the questions that decision-makers ask, and of the problem of goals and the objective measurements of goals—perhaps the most important task before us.