Modelers, Muddlers, and Multitudes: Establishing a Balanced Transportation Planning Process

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Urban model builders and policy makers are turning toward a more flexible approach to planning and implementing urban transportation investments. This paper seeks to extend these recent efforts in unexplored planning processes to enable the newly emerging transportation planning process to better cope with the uncertainties of complex urban and regional systems. The discussion is conceptual and builds on current literature and trends. Diagrammatic representation of "old" and "new" approaches to transportation planning are set out to clarify the nature of the emerging processes. The paper concludes that the trend away from highly structured analytical methods of planning toward more synthetic and open-ended approaches is worthwhile but should not be overdone. What is most needed is a delicate balance between rigorous analytic techniques and less rigorous synthetic and qualitative ones. It is through such balance that technicians (analysts) will work closely with politicians and other policy makers (synthesists) to provide flexible, responsive, and carefully thought-out urban transportation planning.

As the inherent uncertainty of our various environments has made itself apparent (often painfully so), planning interventions into these environments have become increasingly flexible and open-ended to accommodate the unpredictable. There are many combinations of existing, extinct, or innovative configurations of land use and transportation to cushion such uncertainties. The techniques available for identifying, choosing, and implementing suitable combinations are also many. But technical knowledge is not sufficient. What is needed is a planning process appropriate to an uncertain and dynamic urban environment.

Significant strides have recently been made toward developing planning processes capable of handling the multidimensional complexity of urban systems. The emergence of such processes has been particularly noteworthy in transportation planning, which is the focus of this paper. A report from a recent Philadelphia workshop on communication among planning professionals and researchers explored the differences between this emerging transportation planning process and more traditional approaches (1, p. 6):

> The "old" process in this somewhat overdrawn dichotomy can be described as long range, comprehensive, top-down, end state, closed option planning, based on the engineer-architectonic approach that requires a detailed, fixed end product from which everything else is subsequently determined, the whole predicated on the belief that it is possible to forecast future events. The alternative, or the emerging "new" process, is characterized as short range, incremental, politically open, and multi-optioned in the sense of narrowing but not eliminating choice. Methodologies and techniques for the emerging paradigm have not been settled upon, but the intent of sketch planning and quick response analytic procedures is in this direction. The shift, technically, is clearly well underway, but there is still a long way to go.

Central to the "new" process is the need for information and communication among those involved. Much of the burden of information generation and processing has fallen on urban simulation models of transportation and land use. With the shift from long-range to short-range priorities and from single-purpose comprehensive plans to multiple incremental policies, the demands on technologies for generating and processing information are significant.

It is the goal of this paper to explore

1. The utility of existing models in light of these changes in the transportation planning process,
2. The demands imposed on modelers and future models to meet the needs of this evolving process, and
3. Some approaches to model building that are compatible with these evolving needs.

To accomplish these tasks, the paper first briefly explores traditional transportation planning and then examines the new process in contrast with traditional approaches. Next, a framework for discussion is set out to examine the present and the future of models and model building in the context of the planning process. Finally, ways are suggested to enable the model-building process to complement the planning process.

THE OLD PROCESS

In reading any of the standard references on transportation planning, one is immediately struck by the order and neatness of the process. It is well structured and highly rational. It is designed like any other production process, the output being a comprehensive transportation plan rather than an automobile or a dishwasher. The similarity to processes designed by engineers is quite reasonable given the origins of urban transportation planning in civil engineering. As such, the "old" process reflects its roots and also its formative era—the 1950s, when the world's problems seemed capable of straightforward (if large-scale) engineering and design solutions.

With such a history, the striving for analytic rigor in the planning process and technical efficiency in the end product is to be expected. Urban and regional planning generally followed similar paths during the 1960s and early 1970s. These and other related academic disciplines are built implicitly on assumptions of order and predictability in the area being studied. Such assumptions, although analytically tidy and emotionally comforting, do not bear up well under "battle conditions" (i.e., actual as opposed to hoped-for or assumed conditions).

It is inevitable therefore that the old must give way to a newer approach. The rationality, rigor, efficiency, scale, and order of the metropolitan transportation master plan must pass into history.

THE NEW PROCESS

In a world drifting toward disorder, the quest for order is laudable but fraught with difficulties. Just as our own biophysical environment eludes the chaos of entropy through the openness of the system (open here with respect to energy inputs from outside), so must planning processes become open-ended to avoid the chaos that results from imposing order on inherently uncertain and dynamic urban systems. The rigidities of large-scale high-rise public housing and urban renewal schemes, urban freeways, rail rapid transit, green-belt girdles, and single-use zoning must be replaced by more flexible approaches to perceived problems. To complement analytic skills, synthetic ones need to be sought and refined. The restraints imposed by the narrowness of technically efficient evaluative criteria must be expanded to acknowledge political realities. Transportation planning—indeed, all planning and public decision making—is, when stripped to its essence, a political process. The politics of the process need and deserve to be placed in their proper perspective and context.

These are the kinds of demands that are currently being placed on transportation planning. (It should be stressed that what is said here about transportation planning applies to other forms of urban, regional, and even development planning as well.) To accommodate these demands, the new process must have many of the attributes that Lee, the chronicler of the Philadelphia workshop, ascribes to it (1, pp. 4-12). It must also include other features. For example, the emerging process should foster an appreciation of political necessities in the minds of professional and technical participants and also inform politicians and citizens of technical requirements and constraints. As the Lee report stresses (1, pp. 13-17), communication is a key ingredient. Communication of the sort required can only be built on mutual respect among participants in the process.

Perhaps the most important new element in the emerging process is politics. Politics, politicians, and political considerations are no longer viewed as antithetical to "good" planning but are acknowledged to be fundamental. Indeed, a strong case could be made that the short-range, incremental, and multioption features of the process are a direct result of politicizing it. Thus, Lee emphasizes the changing attitudes of professionals toward politicians and directs much of the text of his workshop report to the increased need for better communication among politicians, citizens, professionals, and technical people involved in transportation (1, pp. 5, 9, 13-16).

Significant changes are already well under way. Compare, for example, Figures 1 and 2. Figure 1 is taken from a 1968 overview paper on transportation planning (2, p. 154). Though it is barely 10 years old, it exemplifies the highly rational structure of traditional approaches to transportation planning. Information flows are unidirectional in general, and a nice, crisp organizational structure permeates the whole. In contrast, Figure 2 (3, p. 8) shows a more recent schematic view. Here we see that the political process is an integral and pervasive element in the planning process. The dramatic difference reflects the distance that has been covered in the very recent past and points the way toward equally dramatic, though less obvious, directions for the future (4).

To accommodate more heterogeneous participants, the process must employ increasingly simpler methodologies. To accommodate the political process in its various forms, research must increasingly focus on policy issues and researchers must become more accessible to the users of their work. Finally, the analytic skills that predominated to date must be balanced by synthetic skills to bring disparate analyses successfully to bear on pressing short-range policy issues. This lengthy agenda is already being whittled away.

In sum, the emerging transportation planning process is different. It has the capacity to overcome many of the shortcomings of past approaches but also promises to create a whole host of new shortcomings.

Figure 1. Traditional transportation planning process.

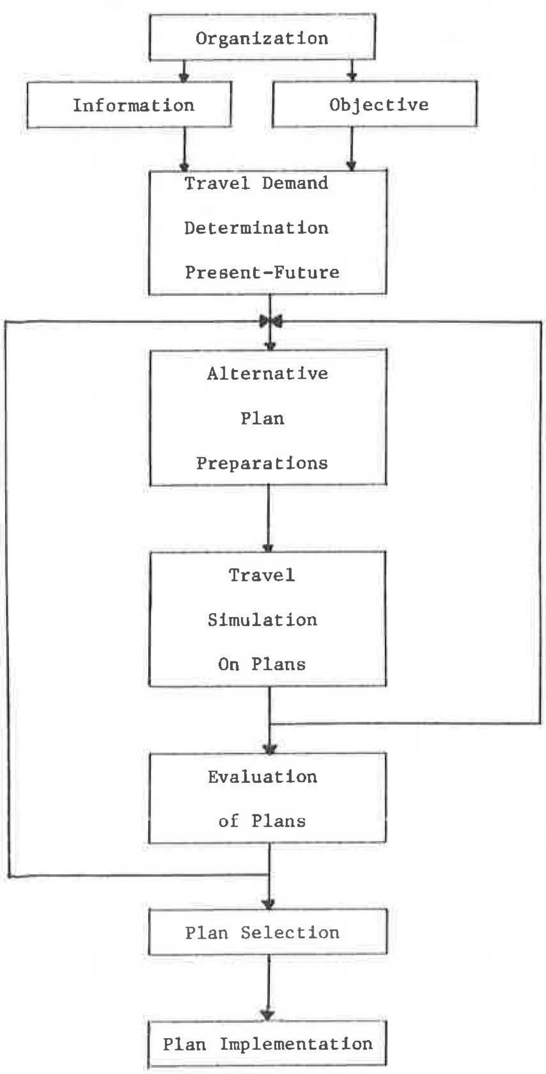


Figure 2. Changing structure of the transportation planning process.

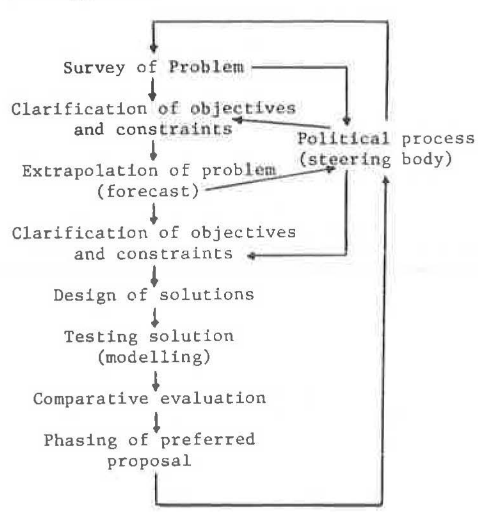
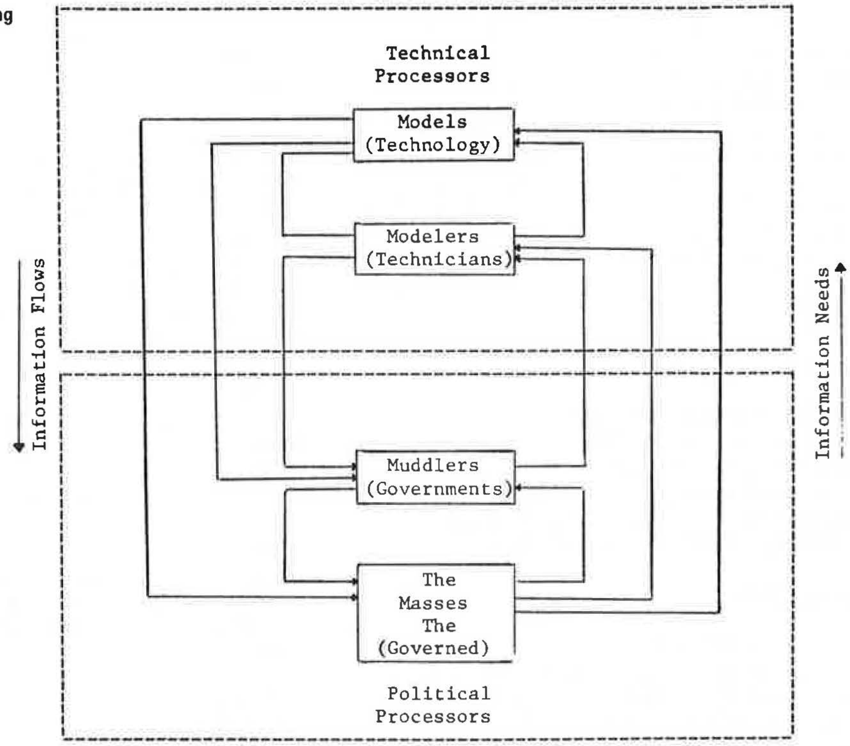


Figure 3. Participants in the emerging transportation planning process.



The Cast of Characters

To make sense of the emerging process and of its implications for its own further evolution and for the future planning of urban areas, it is worthwhile to look at the various actors in the process and to develop an appropriate framework within which they might effectively interact.

Making plans for a system as complex and diverse as an urban region requires, among other things, an extraordinary amount of information and people to generate and digest the information. Organizing such planning processes even schematically is not a trivial task. The schematic variants rapidly approach in complexity and number the complexity and diversity of the urban region itself. Several different views of planning processes and model-building processes have been set out diagrammatically elsewhere (5, pp. 150-151). Lee offers yet another complementary visual aid to understanding and therefore potentially aiding the planning process (1, pp. 1-3). Given the changing nature of the transportation planning process, it is useful to offer another diagrammatic description to provide a framework for discussion and analysis (Figure 3).

There are four groups of information processors and generators:

1. Models—The models of concern here are conceptual constructs and their computerized analogs that provide simulated policy impacts as outputs. Models are generators of simulated information and also processors of raw data and policy variables. They represent the product of the model-building process at any one point in time.

2. Modelers—Models are designed, debugged, calibrated, and run by technically trained people. The modelers receive information inputs from their clients (politicians, bureaucrats, and citizens) and from the models themselves. They also generate information to develop, refine, and run the models as well as provide technical guidance to model users.

3. "Muddlers"—Muddlers are bureaucrats, politicians, and all servants of the citizenry at large who receive information both from the models and the modelers relating to the simulated effects of contemplated policies. They also receive information from their clients, the polity. Muddlers also provide information: For modelers they provide goals and objectives for model construction and policy, and for models they provide policy inputs and needed data. To the people go their policy decisions and their rationales.

4. The masses—Ultimately, in a self-governing democratic society, all this planning and policy making is done because "the people" want to improve the quality of their society and view such efforts as essential if needed and perceived improvements are to occur. Ideally, the masses receive information from their representatives (the muddlers), from their representatives' representatives (the modelers), and from the representatives' representatives' technologies and expertise (the models). The masses in their turn provide the essential political context within which all this information generation and processing takes place.

Of course, complex categories such as those chosen above begin to blur at the edges. It is my intent here only to sketch the principals in the process and their interactions in the broadest terms. This is intended as a didactic and not a definitive exercise.

Defining Appropriate Roles

By fixing the boundaries of responsibility of the interacting elements in the planning process, we can begin to ensure that each will operate within its appropriate sphere and not dominate so that the process does not become subservient to any one or more of the elements of which it is composed. The first two groups are essentially processors of technical information. The last two are more concerned with political issues surrounding the establishment of weights for decision making and of goals and objectives for the transportation planning process in the larger sense.

This process can also be viewed as one of information flowing down through the various interacting elements and requests for information flowing upward. As we move down through Figure 3, we move from agents to clients until we reach the fundamental client in a democratic society—the masses. When the process is viewed in this oversimplified context, it should be obvious that anything that impedes the flow of either information or requests for information (i.e., anything that in essence cuts one of the lines of communication among the actors) can destroy, or seriously damage, the entire process.

Putting Models in Their Place

Information and the meaningful communication of information occupy center stage in this schematic. Models must serve their masters. By placing models (and modelers) in this framework, the challenges that face future modeling efforts as well as some of the problems that confront existing models become clearer.

Utility of Existing Models

During the past two decades, a great deal of progress has been made in the development of urban simulation models, mostly as an adjunct to the transportation planning process. A number of benefits that are valuable for the future have been derived from these past activities and represent a positive legacy of past and current modeling work. Experience with models has also uncovered some serious deficiencies.

The usable features of existing models include the following:

1. Technically sound models have resulted from past modeling efforts. The entropy-maximizing models of Wilson (6, 7) and others establish an analytically neat, computationally efficient, and usable framework. The econometric models of metropolitan development by Kain and Quigley (8) and Straszheim (9) of the National Bureau of Economic Research represent significant strides in the application of economics to modeling. Putman's work on interactive transport and land-use models (10) has moved us ahead by directly linking access and land-use activities. There are also numerous bibliographies on the subject (2, 10, 11).
2. A fund of model-building expertise grew out of past modeling activities. Communication among these technical experts is excellent, resulting in a well-informed, relatively closely knit group of researchers armed with powerful technical skills that can accommodate the changing demands being placed on models and modeling. A fund of model-using expertise is also developing (12).
3. Large-scale data bases and data-handling systems have come into being to cope with the ravenous data requirements of most models. Since future models are likely to be more modest, past gains in the field of large-scale urban data collection, manipulation, storage, and retrieval should be more than adequate to meet expected future demands.
4. Large, fast, interactive, and graphic computer hardware and software enable existing models to be run economically and be potentially widely available. Present hardware and software capabilities appear adequate to meet any unforeseeable future demands.

Given technical considerations alone, current models and modeling expertise provide some essential preconditions for the next generation of models that are likely to be needed by the more open-ended and incremental emerging process described above.

The deficiencies of existing models include the following:

1. Until very recently, high cost and limited output characteristics typified most existing models, severely restricting their usefulness.
2. Comprehensive incomprehensibility characterizes a large portion of the current stock of models. Their comprehensiveness makes them incomprehensible to all but a very few highly trained technical people who have the opportunity to work directly with the models. It is not surprising that potential users are discouraged at the outset from using tools that they cannot understand.
3. Limited access to models, model builders, and computer machinery also restricts the utility of current models. This, combined with technical complexity, further constrains the potential success of existing modeling.
4. Lack of policy inputs and outputs hinders many current models. Without relevant policy variables, it is perfectly understandable why policy makers and their clients—the public—have shown little interest in making better use of models.

Despite technical achievements, current models have not realized their full potential, often because of the technical rigor and awesomeness of modern computing machinery. Much greater emphasis must be placed on making models useful and usable if they are really to become an integral part of the more broadly based emerging transportation planning process (5, 13, 14,).

FUTURE DEMANDS ON MODELS AND MODEL BUILDING

Weaknesses in current modeling efforts point the way toward future needs (5). The overriding need is to fully appreciate the context within which modeling takes place. In this context, a number of specific issues come to mind:

1. Smaller, less ambitious models would appear to be an obvious and direct consequence of the deficiencies of current modeling. Such models should be much more easily understood, dramatically less expensive to operate and refine, easier to program for different hardware and software configurations, and, as a result, markedly easier to use.
2. Special-purpose models such as Huff's 1962 retail model (15) are needed. Simple in design and structure and directed toward well-defined transportation and land-use elements, such models have the potential for ready acceptance and use because of their high degree of specificity and singleness of purpose. Models for specific public facilities; for specific recreational uses such as local parks, golf courses, fitness activities, and playgrounds; for high-rise and low-rise offices; and for other quite narrowly defined land uses and transportation activities would be consistent with both the needs of the emerging process and the foregoing comments on smallness. During the past half-dozen years, this has begun to happen (16, 17).
3. Modular submodels easily combined to form more comprehensive, but still relatively simple, models are also in the offing. By building larger, if still simple, models from well-defined, well-designed, and well-used submodels, economies in operating characteristics can be achieved while the compound models are kept sufficiently elemental to allow different kinds of users to

understand their structure, logic, and use.

4. Interactive and graphics capabilities of the present generation of computers should be exploited to the utmost. Current hardware and software packages enable programs to be used at numerous locations by diverse users and provide graphic output that can be designed to increase understanding and use of models. The computer technology exists to make models more accessible, comprehensible, and thus usable to ever wider audiences. Every effort should be made to take advantage of these technological achievements.

Simpler, special-purpose modules can potentially overcome the weaknesses of existing models, exploit computing technology, and assist the planning process.

ISSUES OF MODEL-BUILDING STRATEGIES AND PROCESSES

Just as transportation planning takes place in the confines of a larger transportation planning process, so does model building go on within a larger model-building process. If that process is to achieve goals that are consistent with the new transportation planning process, a number of strategic points are worthy of consideration before new modeling activities begin (5, 13):

1. Interinstitutional modeling teams hold the promise of providing technical modelers with real-world inputs, constraints, and uses for models. Such a blending of policy-making skills opens the possibility of achieving the best of all possible worlds through choosing the most appropriate technical elements and bringing them to bear on the most important practical issues (18, pp. 629-34).

2. The evolution of models should be allowed for. Placing modeling in an evolutionary framework highlights the process nature of model building as opposed to a pure production orientation designed to produce models. Models of dynamic systems must themselves be capable of change. Keeping sight of the model-building process allows for such evolutionary change.

3. Demystification of models is also a high priority. It would be helpful to remind unsuspecting users that, after all, "models are only human." They have weaknesses and are far from infallible. Only through sufficient attention to weaknesses and clear and simple elucidation of the structure and function of any given model can the user (ultimately the public) be protected from inappropriate application and use of modeling technology in relation to pressing policy questions.

4. Disposable institutions should be found to house models, and the life of both the models and the institutions should be gracefully ended when they are no longer useful. The North American urban landscape is dotted with formerly useful institutions that have taken on lives of their own quite independent of their original purpose.

Model-building processes are subordinate to the higher order transportation planning processes discussed earlier. If models and modelers develop in this larger context, they are likely to continue to play important roles in the emerging transportation planning process. Otherwise, I suspect they will be returned to the academy from whence they came.

CONCLUSIONS

In any range of disciplines, a shift similar to that under way in transportation is noticeable. The almost obsessive concern with rigor, analysis, and precision that has come to typify inquiry is being replaced by calls for more relevant integrative approaches (18). "Value-free" economics, sociology, anthropology, history, and so on are being challenged by unabashedly value-based research. Awareness of the need for synthetic skills, for sound processes as well as sound products, and for generalists as well as specialists illustrates this point. Lee directs attention to many of these issues (1, p. 20) as I have done (5). More frightening than the continuation of analysis uber alles is the possibility that professionals will respond to these exhortations and abandon sound analytic tools in favor of synthetic ones alone.

The point is that both sets of skills are essential. In a strict sense, there can be no good analysis without some sound, previously synthesized hypotheses. Similarly, without analytic evidence there is nothing to synthesize.

Accordingly, if the new emerging transportation planning process degenerates into just another (albeit synthetic and process-oriented) technology, I would anticipate that its impact will be of short duration. If, on the other hand, the emerging process acts to bring together varied and needed skills of analysis and synthesis in an evolutionary and dynamic setting, then its promise for significantly improving transportation and, more generally, urban and regional planning is great.

Balance is called for between the paired elements of product and process, analysis and synthesis, individuals and societies. This is the real challenge facing planning and decision-making processes in our societies. This is where better communication can have its most telling impact. By providing bridges across the gaps between elements, communication can begin to engender some sense of the total effort required to plan and administer our urban and rural environments. By engendering respect for specifics among generalists and respect for generalities among specialists, communication can help those who formerly held a dichotomous view of the world appreciate that at best they represent only half the picture. Technicians without policy makers to implement technically based suggestions are likely to be as helpless as policy makers who face technically based decisions in the total absence of knowledge. It takes both engineers and politicians to build highways, subways, and city streets.

Open-minded and cooperative participation in the process is a necessary condition for success. Attitudes change slowly, usually for good reason. For attitudes to change, they must, among other things, be shown to be inadequate to current needs; simultaneously, it must be shown that there exists an alternative set of values (attitudes) that are more appropriate. The new transportation planning process does have the flexibility and breadth to foster diversity, to bring differing attitudes in contact with each other, and ultimately to provide for the evolution of attitudes that are needed to complement the evolution of the process itself.

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How to Do a Transit Station Land-Use Impact Study

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Several improvements in the conceptual basis and methodology for studies of land-use impacts have occurred over the past two decades, but the framework is still incomplete because the need to incorporate the policy context into the study design has not been fully recognized. A revised model for impact studies is proposed, and the approach is illustrated by a case study of a planned rail rapid transit station. One of the major differences between this and previous methods is that the method described in this paper acknowledges several possible outcomes or impacts as a function of alternative public policies in addition to the transit station itself. Five categories of impacts are evaluated: public facilities, environment, market, neighborhood, and costs and revenues.

The purpose in asking the positive question, What are the land-use impacts of a major transportation project?, is to evaluate better the feasibility and desirability of such projects, and the answer to the question depends heavily on public policies other than the project itself. The theory and case study presented here are an attempt to construct a workable framework for executing land-use impact studies of major transportation investment projects from a planning- or policy-oriented perspective.

IMPACT MODEL

Refinements in the before-and-after and the more recent with-and-without impact methodologies have advanced the state of the art (1, 4), but the model, derived from experimental design in the physical and natural sciences, is still incomplete. Figure 1 shows schematically an extension of the with-and-without model in which the comparison is made between two sets of outcomes ("options" because they are a consequence of conscious policy choices) that result from the decision to build or not build the project. State-of-the-world assumptions are things that are held constant for comparative purposes: regional population and employment growth, aggregate travel demand, and the rest of the transportation system. Policy assumptions, in contrast, are specific to each option: For example, policy assumptions associated with intensive redevelopment are different from those associated with neighborhood preservation. The impact of the project is the difference between (a) the options available without the project and (b) the options available with the project.

Previous impact studies and the proposed model can be distinguished, in part, by the way the question is asked. In relation to the case study of the Metro transit station in Vienna, Virginia, the old research question is, What will happen if a transit station is placed at I-66 and Nutley Road? The policy research question is, What will be the differences between the choices available if a transit station is or is not placed at I-66 and Nutley Road?