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Do Transport Planners Need Incrementalism?

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Abstract

Most current research work in transport modelling focuses on the development of models, such as activity-based models and land use models. There has been limited exploration of the adequacy models for transport policy making and transport policy makers. Model frames do not usually encompass all the issues policy makers need to consider. Conventional models based on rational analysis of facts deal poorly with decision processes which encompass seemingly irrational opinions. Understanding the factors underlying policy-makers decisions would contribute to bridging the gap between transport modelling analysis and genuine transport policy. Efforts in studying these decisions would have wider benefits. The decisions encompass community preferences. Better understanding of the range of factors influencing such preferences is needed for modelling the complex transport and travel options under consideration now.

Incrementalism is a tactic for addressing human behavioural impacts on policy-making. Cognitive psychology offers insights in understanding such behaviour. This paper explores implications of incrementalism within the context of transport planning and modelling. Incrementalism can act as a philosophical guide for transport planners. Rather than replace current analytical methods, incrementalism combines these methods in a strategic framework with methods to address previously unexplained behaviour, by including factors not conventionally considered. As a complement to the framework, the theory of satisficing thresholds can be applied to assist solution of the resulting complex multi-objective formulations. The advantage of such an approach is the formulation of plans and policy set closer to the nature of problems.

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Introduction

Transport policy makers rely on planning models to make strategic decisions. Four kinds of models are currently used by transport planners: conventional four-step transport models; behavioural travel-demand models; linked urban land use transport models; and integrated urban land use transport models (BTE 1998). On-going research has been focused on the development of models themselves. Studies of application environments and requirements are few. But such studies are equally important. Wachs (1998) notes that currently the application of transport planning models in urban land use policy analysis is weak. Impacts such as uncertain political pressures have not yet been well addressed in current modelling practice. Thus the results of modellers' analysis and the meanings of model structure cannot fully meet the needs of policy makers. The range of policy implications explored through current modelling is not adequate.

Finding tools to bridge the gap between modelling analysis and genuine policy becomes a professional objective (Dahms 1998). But finding an appropriate tool will be increasingly difficult due to the dynamic nature of society. Seemingly irrational behaviour by decision makers and travellers (Xu and Smith 1998) complicate the process. Apart from current empirical rational modelling frameworks, there are other methodologies suggested for use in transport planning such as *satisficing* (Purvis 1998) and *threshold* (Young 1986). The phrase *incremental* has also been increasingly seen in the transport literature (see examples: Guria 1999; Button and Johnson 1998).

Caution however should be exercised before applying "vogue" terms in research. There is a distinct difference between incrementalism and incremental steps. Incrementalism was first formally introduced by Lindblom (1959) and has been traditionally used by policy makers to solve public administration, budgetary, organisational and political issues. It is a tactic for addressing uncertainty and behavioural impacts which sometimes may appear irrational. Incremental steps are however physical symbols represented in the implementation of incrementalism.

This paper focuses on exploring the significance of incrementalism to transport planning. It then suggests that transport planners should improve practicality and policy sensitivity of models by adopting an expanded planning framework which strikes contrast with current rational planning. Satisficing and threshold methodologies are introduced to complement the framework.

Transport modelling challenges

Transport models are tools for transport planning and policy development. Transport modelling establishes quantitative and/or qualitative models. These can then be used to represent studied objects, their relationships and environment. Good modelling is judged on the fitness with which data attributes are embodied by mathematical formulae of the model and its parameters in terms of statistic properties

Today transport modelling is increasingly driven by requirements to better predict the interaction between transport systems and land use developments. Understanding this interactive relationship is crucial to developing appropriate models for transport planning and policy. Two current research directions - activity-based travel modelling and land use modelling - address this challenge.

Activity-based modelling

The paradigm of activity modelling is a shift from earlier travel demand model paradigms. Empirical models estimated rather than explained travel demand. The ubiquitous four-step model (Button 1977), for example, followed a trip-based paradigm. Sub-models first estimate the total number of trips generated and then proceed to allocate them to destinations, transport modes and routes in the order of trip generation, trip distribution, modal split and trip assignment (BTE 1998). With a fixed decision sequence the four-step model requires stable situations and consistent travel demand. Criticisms of trip-based analysis include its inability to provide realistic models of travel and travel behaviour (Kurani and Lee-Gosselin 1996).

The activity-based paradigm suggests that trip generation is not simply dependent on aggregate residential socio-demographics The generation is diverse and disaggregated, and influenced by proceeding trips. The trip-activity dependency revealed by the paradigm sets the condition for trip generation and choice of trip destination. An activity modelling framework then limits the choice set of trips destinations in respect to where and when the trips originate.

Activity analysis traces back to trip purpose and uses trip-activity scheduling diagrams to replace trip generation. It incorporates dependencies among trips and between people, and constraints on activity participation and travel behaviour. The phenomena of participation in in-home and out-of-home activities, dependencies among household members, and daily activity-travel patterns are studied (Pas 1996).

The chaining characteristics and constraining factors are the highlights of the tasks involved in activity modelling (Bowman and Ben-Akiva 1996):

- Analysis of demand for activity participation;
- Scheduling of activities in time and space;
- Analysis of constraints on activity and travel choice;
- Analysis of interaction between activity and travel choices over the day and between individuals;
- Analysis of the structure of the household and the roles played by the household members.

A new generation of transport demand modelling is being built on the activity approaches (Ettema and Timmermans 1997). As the causal relationships inherent in activities and trips are studied, such models possess richer analytical and forecasting poereand have the potential to address policy actions. However, up to now, such a conceptual framework has faced implementation limitations. Big hurdles for searching for activity solutions are the trip chaining associated with multi-purposes and multi-stops and the constraints on activity participation within households. In the first activity-based travel model - AMOS (Activity-Mobility Simulator) (RDC, Inc. 1995), limitations were obvious in the number of assumptions required. Even the newest activity model TRANSIMS (Bush 1999) still requires most of these assumptions. Great efforts are needed to advance both theory and methodology in activity modelling. Basic issues which need to be addressed, as Kurani and Lee-Gosselin (1996) stated, include:

- Why households and their members engage in different activities;
- How physical and social environments provide opportunities for activities, resources to access these activities and constraints limiting the access;
- How households and their members learn those environment;
- How people process their activity needs and their knowledge of their environments to develop schedules of activity.

Land use modelling

Land use research covers a wide range of issues from land pricing to air quality. Traditionally land use modelling has usually considered transport implications. Where people travel is directly associated with land use patterns: residences, workplaces, retail centres, in other words the sites of their activities. More recently, it has also been realised that transport supply can also influence land use. For example, if road capacity is expanded, opportunities for changing land use arise. Land values change with transport access. Transport access influences the market for land for residential use, office or retail development (Dunphy 1995).

Currently, there exist over a dozen operational land use and transport models which have been used for applications in cities all over the world (Wegener 1995). The importance of this type of modelling is growing with increasing concerns about transport impacts on the environment. Legislation such as the 1991 Intermodal Surface Transportation Act of the US requires transport modellers to consider the interactions between transport systems and land use. Yet land use transport modelling still follows patterns first established over thirty years ago, see for example Garrison (1965). Most models currently used are aggregate in substance, space and time (Wegener 1995). They are also captive to a tradition of economic equilibrium rather than disequilibrium dynamics which better describe reality. Few are behaviourally based (Weatherby 1995). The challenge for land use modelling is the inclusion of behavioural components and ideally, activity components, into modelling.

Policy

The third challenge is from policy requirements. In most cases, the transport modelling process does not end with prediction of travel demand and land use patterns. It goes on to explore impacts of transport initiatives. The AMOS model discussed above was established for examining various Travel Demand Management (TDM) measures. TDM measures such as parking charge and congestion pricing are simulated by the model. The transport authority can then select appropriate policies, to lead to better transport outcomes.

Transport models for good transport policy should be internally consistent and be able to accurately replicate travel behaviour patterns (Giuliano 1998). Existing models have been criticised as not sufficiently sensitive to policy issues (Weatherby 1995). The lawsuit in California brought by environmental groups against the Metropolitan Transportation Commission (MTC) highlighted the limitations of urban development and transport models used for policy analysis (Khattak et al 1996).

Current transport models have insufficient understanding of the decision-making process in which people make decisions about where they live and how they choose transport modes. The models also have insufficient understanding of the decision-making process of policy makers who are influenced by their own preferences. Yet as Koppelman (1998) noted that "we need to be mindful of human and institutional preferences and humble about our understanding of them". When politicians exert impacts on transport policy and policy makers rely on transport modelling to produce sensible policy options, transport modelling needs to adopt a more comprehensive perspective then common empirical modelling. Empirical modelling frameworks typically cover only a portion of the issues that public officials must take into account (Dahms 1998). Such modelling results are not sufficient for policy-makers constrained within a political context.

Moreover, even if all relevant issues are identified in modelling process, there is still a challenge in collecting all the information required (Xu and Smith 1995). In no modelling situation will there be complete information about all decision-makers preferences, all activities varying on temporal and geographical scales and all land use options.

A real challenge for transport modelling is the need to produce practical and sensible policy options, despite a lack of understanding of the decision making process involved by both travellers and policy-makers, and constrained by limited information

Incrementalism

Incrementalism is a philosophic way of dealing with real decision-making Transport planners need incrementalism when handling the uncertainty involved in transport planning and modelling. The uncertainty here refers to both incomplete information and discipline limitations in interpreting decision-making processes.

Bounded planners

Incrementalism suggests that in most complex decision situations humans do not have the time, cognitive capacity, resources, or theoretical understanding required for envisioning all conceivable options and for analysing all consequences of those options that do get considered (Weiss and Woodhouse 1992). The rationality of transport planners is bounded. The decisions made on bounded rationality might appear "irrational" to some observers.

On one hand, transport planners lack complete information On the other hand, they are confronted with a mass of information, some of which might be irrelevant. It is difficult for transport planners to isolate all causal relationships in this information. Decisions made are "conditionally rational" based on partial information. In the activity modelling situation, planners cannot consider all options of activity-trip chaining and scheduling for all individuals at one time. Nor can such conditionally rational thinking be fully modelled.

The recognition of the bounded human rationality echoes Simon (1957) noting human limitations in utility maximisation. Perrow (1984) summarises succinctly the implications of this view of the bounded rationality of decision-makers.

> *"Given the limits on rationality, what does the individual in fact do when confronted with a decision situation? He constructs a model of the real situation. This 'definition of the situation', as sociologists call it, is built out of past experience and highly particularised, selective views of present stimuli. Most of his responses are 'routine'; he invokes solutions he has used before. When engaging in problem solving, he conducts a limited search for alternative along familiar and well worn paths, selecting the first satisfactory on that come along. He does not examine all possible alternatives nor does he keep searching for the optimum one. He 'satisfies' instead of 'optimises'. That is, he selects the first satisfactory solution rather than search for the optimum".*

The key phrases describing the decision-making in Perrow's summary are 'past experience', 'routine', 'a limited search', 'satisfactory'. These phrases represent influences which have not been well addressed in current rational modelling frameworks. Human factors are under represented in rational frameworks mainly developed from the perspective of natural sciences The decision-making processes influenced by such factors then seem irrational to empirical rational frameworks. This become obvious where:

- The problems are not well defined;
- There is incomplete information about all alternatives;
- There is incomplete information about the baseline, the background of the problems;
- There is incomplete information about the consequences of supposed alternatives;
- There is incomplete information about the range of and content of values, preferences and interests;
- There are limited time, skills and resources.

Rational decision-making as described by Hayes (1992) is typically a process of mutual adjustment among a multiplicity of actors. Such mutual adjustment seldom describes the interaction between transport modellers and policy makers. Each bring their own, not necessarily convergent, values to the process. While data itself may be value neutral decisions about data selection and modelling processes chosen mean results will not be neutral. Transport modelling should not be presented as objective analysis. Rather the assumptions inherent in modelling should be made clear and their appropriateness to the context discussed with the policy makers. Models of these decision-making processes themselves are needed

Decision-making processes become more complicated when the participants hold different views of the problem and adhere to different sets of values. The decision-making processes for such cases need a model framework expanded beyond mutual adjustment processes. The expansion is important to provide explanatory power for predicting real decision-making behaviour Modelling of the decision process is needed to help transport planners and transport policy makers select and apply analysis processes. The cognitive process suggested by Hedberg and Jonsson (1977) in terms of incrementalism is interactive, learning-adaptive and useful in approaching unknown factors

Bounded travellers

Empirical rational planning holds a key assumption that travellers behave as planners expect. For any origin and destination pair, travellers are expected to seek the path which planners have assessed to offer the best value (usually least time or cost). In such a rational world, planning issues would be simple. Planning would always result in transport systems on which no one who did not enjoy travel

Travellers, however, do not all behave according to the planners view of rationality. They do not always drive along the shortest route. Perhaps they are afraid of traffic conditions on that route. Their preferred route might reflect local knowledge They may choose a route for a particular reason such as stop-over for breakfast, newspapers, shopping or childcare. Most of these factors could be added into the modelling process if relevant information was available and the modelling framework was appropriately set up. But when models do not accommodate such factors, route choice might seem irrational.

From the viewpoint of incrementalism, a model is an attempt to represent reality by abstracting out of a confusing welter of events and observations the essential elements of a situation or an object, and then make preliminary guesses as to what is relevant and how things fit together (Hayes 1992). Incrementalism could help understand why some travel behaviour seems irrational and identify the factors which need to be included in modelling processes for explaining "irrational" behaviour.

Rather than having assumptions of complete information, clear objectives and full resources as in empirical rational planning, incrementalism has the great virtue of being achievable in situations where social and human factors display conflicts and behaviour seems irrational. The key difference between current empirical rational planning and incrementalism as described by Lindlom (1979) is between ill-considered, often accidental incompleteness on one hand, and deliberate, designed incompleteness on the other.

Advantages

The purpose of introducing incrementalism in transport planning is not to replace current analytical methods. Instead the intention is to bind them into a strategic framework with methods to account for behaviour currently not explained. As noted previously, incrementalism is not a process of incremental steps or small improvements as proposed by Fohler and Maki-Turja (1999), Guria (1999), Webb and Larson (1995). Incrementalism is a strategic guide to help identify planning problems and formulate modelling objectives and process. The research and modelling process set up with the assistance of such a strategy will be much closer to the nature of planning problems than a conventional strategy which is an orderly 'grand design' for the future in terms of the formality and regularity of analytical processes.

In this sense, much transport planning is incremental planning (Xu 1998). Incrementalism tends to be strategic and does not treat policy analysis simply as engineering exercise. On the other hand, it proceeds in ways that economise on decision inputs, rather than proceed haphazardly, doing whatever comes to mind and hoping for the best (Weiss and Woodhouse 1992). Such incrementalism helps bridge the gap between transport planning and decision-making process and opens the door to absorb more strategic views such as competitive advantage and entrepreneurial opportunism. This strategic combination with rational analytical methods can produce transport planning results with policy options acceptable to decision-makers. Additionally, there are two specific reasons for transport planners to adopt incrementalism. It provides a better basis for inclusion of results from cognitive psychology and for dealing with satisficing thresholds.

Cognitive psychology

Transport planning work should incorporate knowledge from psychology (Ben-Akiva 1998) to help explain travel behaviour. Cognitive psychology describes human decision-making following the psychological rules. Lampinen (1999) gives the following examples:

Certainty Effect: There is a choice between two wagers:
Wager One: A 25% chance of winning $200;
Wager Two: A 100% chance of winning $50.

Most people will pick Wager Two, even though the two wagers have identical mathematical expected values. Preference of a certain outcome as expressed by the phrase *"a bird in the hand is worth two in the bush"* comes into effect.

Risk Aversion: There is a choice between two wagers:
Wager One: A 100% chance of losing $50;
Wager Two: 25% chance of losing $200 & 75% chance of no loss.

People will pick Wager Two this time to avert certain loss.

Mathematical expected values are the same for each wager set. The probability of gain or loss is the same. Utility estimation based on calculated expected gain would not properly predict behaviour. Psychology research has shown people prefer a certain gain over an uncertain gain even if the uncertain gain might be larger and people prefer an uncertain loss over a certain loss even if the uncertain loss might be larger. These two opposing tendencies known as preference reversal challenge empirical rational decision-making assumptions. Incrementalism could include contributions from cognitive psychology to analyse some irrational behaviour involved in both planners and travellers choice.

Satisficing threshold

Transport planners optimal modelling results are usually sub-optimal, given their incapability to collect and handle all information. In view of the limitations of empirical analytical frameworks, Purvis(1998) has suggested that transport planners should adopt "satisficing" theory. Decision makers do not always optimise utility rather they settle for alternatives which are "good enough" (Simon 1957). Satisficing applied to modelling frameworks on a strategic level means:

- Doing just enough for whatever is required;
- Achieving the minimum acceptable level of utility;

Satisficing then provides a reasonable approximation to objective rationality, suiting most decision-making situations.

Recently, there has been increasing recognition of the importance of using satisficing theory for complex problems, for example in modelling artificial intelligence AMOS and later activity models, incorporate some bounded optimisation. Activity modelling can start with a few activities to incrementally approach real activity levels by adding in more activities. Complete modelling objectives need not be set initially. Instead objectives may be allowed to arise as modelling alternatives are compared (Pulendran and Speed 1996). Modellers then have to establish satisficing thresholds for activity scheduling and trip chaining which have met required minimum increments of improvement over the status quo.

Satisficing models have been criticised for making arbitrary assumptions about goals and minimum acceptable levels (Nonacs and Dill 1993). However thresholds of insensitivity as introduced by economists such as Slutsky (1952) and Georgescue-Roegen (1958) have a firm base in the theory of consumer behaviour. Satisficing thresholds are a key concept in decisions about how much incremental improvement is enough to be acceptable. In transport planning, trips below a certain length may not be perceived or reported as trips. Neither are activities over time. When the distribution of threshold is assumed to be normal (Young 1986), the satisficing threshold is not arbitrary but statistically testable.

The satisficing threshold has advantages over alternative methods such as Elimination by Aspects (EBA) (Tversky 1972). The EBA method assumes individuals search through the attribute set in order of importance, eliminating each alternative as it becomes unsatisfactory with respect to a particular attribute. But the satisficing threshold can consider trade-off between attributes within alternatives. The threshold applies to all aspects of the alternative rather than to individual attributes. In satisficing assessment of alternatives, both individual attributes and the total attribute set are used.

Threshold definition in transport planning has been attempted in a number of cases (see for example: Smith 1985 and Young 1986). However, the development of practical methods for defining satisficing thresholds demands more work. Work on survey methods to elicit satisficing levels is also needed.

Conclusion

Transport planners need to achieve realistic modelling results when facing the issues of uncertainty and insufficient information. Current transport modelling frameworks are often inadequate. There are numbers of gaps in understanding the interactive dynamics of process. For example:

- It is recognised that urban land use influences travel patterns and that transport supply influences urban land use but complete mechanisms have not been described;
- Travellers behaviour, especially where choices are complex, is not well estimated using conventional explanatory variables. Better understanding of cognitive process is needed;

- Interaction between modellers as suppliers and the demands of policy makers needs to be understood to improve the relevance of modelling to decision-making.

There is an urgent need for improved understanding because there are numbers of applications currently dependent on such understanding. Both environmental and financial pressures are resulting in competing transport demand management strategies which need to be assessed for effectiveness. These range from plans to create compact mixed-use commercial centres with high population densities, linked by high quality transit services (Nelson and Niles 1999), to proposals for urban tollways made more efficient by intelligent transport systems. Transport modellers are required to provide whole of day rather than peak hour forecasts and thus encounter travel decisions which are more subject to limited knowledge and "irrational" behaviour. Even when policy makers are required to consider the results of modelling they may then ignore them in the absence of processes to incorporate their own requirements

Incrementalism provides both short term and long term advantages in this situation. Application now allows better solution of current problems. It is an alternative to the options of continuing to use an old method, for example, four-step modelling, despite inherent limitations or adopting a new method, for example, activity modelling, where current knowledge tightly constrains results. In the long term it provides a process for better problem formulation and gap-filling, especially between policy and modelling. It encourages planners to investigate factors which might explain "irrational" decision-making.

For this potential to be realised, more transport planners need to explore incrementalism. Recipes for application of the technique are not yet available. Perhaps this is because its nature makes it unsuited to explicit prescriptions but equally it might be due to the background on current writers on the subject. A transport planner may be ideally placed to write the first manual. Incrementalism gives birth to incremental planning which is useful to dealing with the complexity of transport systems especially in interaction with the natural, built and human environments. Incrementalism also leads to realisation that there is no one-off transport model to answer all questions for all purposes. To achieve effective, efficient and practical transport models for an expanding range of purposes, transport planners will need incrementalism.

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