Monograph:
Still, B. (1995) Transport Impacts on Land Use: Towards A Practical Understanding for Urban Policy Making – Introduction and Research Plan. Working Paper. Institute of Transport Studies, University of Leeds , Leeds, UK.

Working Paper 433

UNIVERSITY OF LEEDS
Institute for Transport Studies

ITS Working Paper 433 *ISSN 0142-8942*

April 1995

TRANSPORT IMPACTS ON LAND USE: TOWARDS A PRACTICAL UNDERSTANDING FOR URBAN POLICY MAKING - INTRODUCTION AND RESEARCH PLAN

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TRANSPORT IMPACTS ON LAND USE; TOWARDS A PRACTICAL UNDERSTANDING FOR URBAN POLICY MAKING

1 INTRODUCTION TO THE RESEARCH AND OBJECTIVES

This working paper forms a general introduction to an EPSRC CASE research project, presenting the objectives of the research, the rationale behind the study, a summary of some of the results obtained so far, and a plan for the remainder of the research work. The project is due for completion in November 1996.

The objectives for this project are to *determine whether the impacts of transport upon land use can be understood and predicted in a manner which will assist and enhance practical urban policy making.*
In other words, the project is examining:

1. The current understanding of the nature of the influence that transport has upon activity patterns and land use. Specifically, this is making use of empirical studies of transport impacts on land use, plus behavioural studies of the factors in location choice.
2. Whether this relationship can be adequately represented in a predictive context. This consists of two elements. How the relationship of transport on land use can be studied and 'formalised', and secondly, the ability to use this relationship for estimation of land use response to transport impacts. Use will be made of published modelling studies, plus some original modelling work, using a model constructed for this research.
3. The benefits of predicting transport impacts upon land use to planners involved in strategic land use and transport planning. This is the main objective of the research, and addresses why transport impacts on land use appear to have a minor role in structure planning, why model representations are seldom used, and given a model's predictions, what use will be made of the model results. Initial results from the first round of interviews are given in this paper.

There are several themes that underpin this research:

- The nature of the 'transport on land use' relationship. How far it can be formalised, what we know about it, and how it is best to study it.
- Strategic planning processes in the UK, how the planning system handles the transport on land use relationship, under what circumstances the relationship is important, and the role of model predictions in the planning process.
- Whether the remit of 'planning' *should* examine transport impacts on land use, plus anticipation of the impacts of local government reorganisation.
- The issue of whether predictive modelling in this context is an appropriate tool beyond the scope of academic research.

2 RATIONALE AND CONTEXT

There is a strong rationale for this research, clearly shown from the results of the first round of interviews, as described in section 5. The reasons can be divided into two elements: (1) recent policy developments in co-ordinating land use and transport; and (2), emphasis on modelling in the planning process.

The desire for integration of land use and transport planning has sprung from several sources. Environmental concerns have led to policies to reduce transport emissions targeted at reducing travel by private modes. The main policy instrument produced to do this was PPG13, (DoE 1994), which aims to plan land use to reduce the need to travel by car. Some mention is made in this document of transport impacts on land use, but this longer term influence on urban form is largely ignored in the advice, partly due to the difficulty of cause and effect associated with the relationship (see section 3).

Secondly the 1991 Planning and Compensation Act has placed more emphasis on co-ordinating land use and transport, as has the UK Sustainable Strategy (DoE 1994), and recent publications from planning organisations (e.g. the Association of County Councils 1994) and the Royal Commission on Environmental Pollution (1994). The thrust of these documents is that an understanding of transport impacts on land use is a vital component of any co-ordinated environmental planning policy, which, to be effective, must operate in the long term.

Thirdly, the relationship between road infrastructure and economic development is still under contentious review. Several recent independent reports have strongly criticised the role of roads in economic development (Whitelegg 1994, Bray 1992), and the recent SACTRA report recommended further examination of transport impacts on land use (SACTRA 1994). In the latter report there was a strong emphasis upon evaluating the role of models as a tool for examining the relationship. Furthermore, most research has concentrated on (more obvious) interurban transport infrastructure impacts (e.g. Headicar and Bixby 1992, The MVA Consultancy, 1990), rather than transport's influence on activity patterns and development in an urban context.

The theoretical and technical research concerned with land use and transport models has had a turbulent and chequered history (Klosterman 1994, Batty 1994). However, from the late 1980's there were claims of a 'renaissance' in urban modelling (Boyce 1988) led largely by academic interest, with a range of new models (e.g. Martinez 1991, Mackett 1994), and older models being refined and applied in policy making (e.g. de la Barra 1994, Williams 1994). Also in practical applications, the rise of the integrated transport strategy (May 1991), partly as a means to obtain TPP funding (e.g. Avon County Council 1994) has placed the emphasis on transport models being fast, flexible, transparent, and able to test a wide range of transport (and land use) strategies. However, this renewed interest is not without its critics (see section 4), and there are proposals a for thorough examination of integrated models (DoT 1994b).

This research therefore aims to contribute to the debate concerning the ways in which land use responds to various urban transport policies. Resources will be devoted in particular to examine methodology in the strategic policy context, its application and potential benefits. It is appropriate, in view of the long term policy requirements of environmental objectives, to examine strategic planning as it undergoes its own 'renaissance'.

3 TRANSPORT IMPACTS ON LAND USE: AN INTRODUCTION

The initial concept that transport infrastructure and associated levels of accessibility influence the development and redevelopment of urban land can be traced back to the German school of location theory; Weber (1909), Christaller (1933) and Lösch (1944). However, despite the theoretical simplicity and appeal of the relationship, empirical verification has proved problematic. This is for the following reasons:

- The impact of transport on land use on broad spatial scales is not immediately apparent, and dependent upon many other factors which affect location decision making (such as

economic cycles, socio and demographic trends). These must be allowed for if the impact of transport alone is to be determined.

- There are no counterfactuals for comparison in empirical studies, and as each urban area is unique, comparative approaches with 'control areas' are rarely adequate. Time series approaches are prone to economic cycle fluctuations, as are economic methods of analysis.

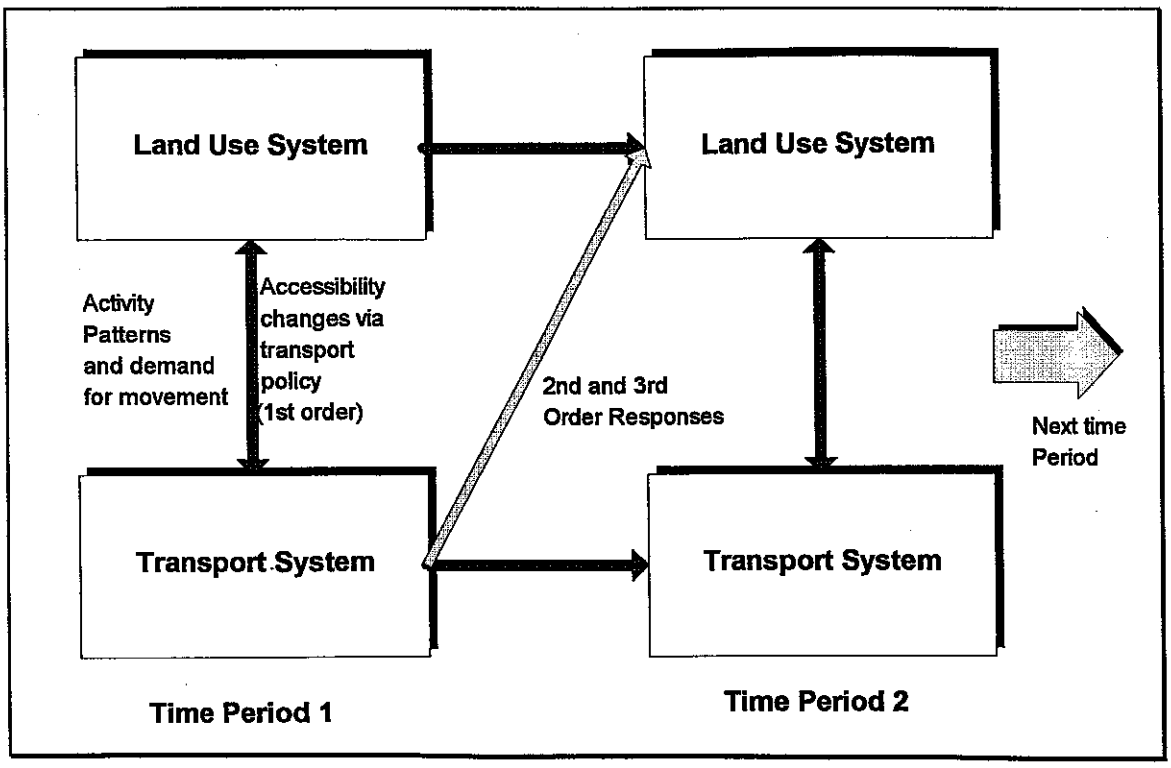
- Generally, the impacts occur over long time periods (at least before changing trends in urban form are visible). Furthermore, the interactions vary in strength over time and space.

- An often sought after indicator is whether transport investment leads to economic growth. However, it is often very difficult to distinguish between generated economic activity as opposed to redistribution of existing activities.

- The above reasons mean that data collection is complex and requires an understanding of the effect *before* the data is collected (Giuliano 1989). Definitions of the impacts, the indicators of the impacts and their measurement techniques are thus vital decisions.

In essence how transport influences land use is a behavioural issue, dealing with the decision making of individuals and firms. As such, theory of choice becomes important in building models of the relationships. Mackett (1994) outlined three 'orders' of response to transport change as follows. First order response is that traditionally captured in transport models, changes in mode, time of travel, route or destination. Second order responses involve shifting location (of firm or house etc.) within the existing stock as a result of changing patterns of transport costs. Finally, the third order response is that of new development appearing as a result of changing perceptions of accessibility. This of course changes the option set for future second order responses (see figure 1). The key indicator in the relationship is the effect on **accessibility**, but recently the role of transport in terms of **environmental quality** and its impact on **image** are also seen as important.

It is the second and third order responses that are the subject of this research, in short, whether meaningful representations of these responses can be obtained, how these can be incorporated into a model and whether using these in a predictive context is of value to planners.



Simplified Diagram of the Land use and Transport System
(adapted from Hunt and Simmonds 1993)

4 RESEARCH PLAN METHODOLOGY

The research falls into three parts. Between them they meet the three objectives stated in section 1. A provisional thesis structure is included as an Appendix.

4.1 BACKGROUND THEORY AND RESEARCH: THE NATURE OF TRANSPORT IMPACTS ON LAND USE

This section examines the nature of the relationship via a review of the empirical, conceptual and modelling work carried out to date. The empirical review includes the impact of LRT and road investment on the urban form in general (e.g. Walmsley and Perret 1994, Lawless 1995), plus those studies examining local and corridor effects. The emphasis in general is upon longer term and wider scale impacts. Empirical study of location decision making is also examined, for firms (e.g. Lloyds Bank 1995, Nelson 1995), households (e.g. Headicar et al 1994) and developers (e.g. Baerwald 1981).

The relationships embodied in models of transport impacts on land use are also reviewed. There are several areas of interest. Firstly the study of location theory, including neo-classical location theory (Alonso 1964), behavioural theory (Harvey 1969), and structural theory (Massey 1984). Secondly 'economic potential' models (e.g. Linneker and Spence 1991). Finally, land use and transport (spatial interaction) modelling will be examined in more detail, as its characteristic (of being able to represent transport policy explicitly on a network basis) is most appropriate for this research.

The third element in this part of the research is the policy context. The history of transport and land use interaction in planning is reviewed, in addition to recent policy documents. The results of interviewing a sample of planners and academics are then presented, setting the context for the following research. The issues discussed at this first round of interviews included current planning practices with regard to transport impacts on land use, the use of models and other methodologies, and perceptions of the importance of examining the land use response to strategic planning. A summary of this research is contained in section 5.

An international policy context will be obtained from a series of overseas interviews examining the transport impacts in other planning systems[1]. This will address whether transport impacts on land use are incorporated into overseas planning systems, current policy trends, the experience with models, and the perceptions on land use transport relationship.

4.2 THE RELATIONSHIP BETWEEN TRANSPORT AND LAND USE MODELLING; APPROACHES AND RANGE OF EFFECT

This section is concerned with the updating of an existing simple land use 'indicator' model, plus the development of a new type of more complex land use model, both in conjunction with the CASE sponsor. A case study area of Lothian Region has been selected, with the agreement of both Lothian Regional Council and the Scottish Office.

The 'indicator' model, (DSCMOD) has already been applied to the case study area (Simmonds 1991), and requires updating and re-testing for the desired transport strategies (see 4.3). The

[1]This element of the research is supported by a Brian Large Travel Bursary.

structure of the new model has been conceived by the David Simmonds Consultancy, and will be developed and applied to the Lothian Region case study as part of this research project[2].

The land use model is to be used with the existing START model for the Lothian and Fife area, developed by The MVA Consultancy (Bates 1991). The use of an existing model has several advantages in the context of this research. Firstly the START model has been used in 'practical' transport planning with some success (May and Roberts 1995). Secondly, the model is amenable to having an interactive land use model 'built into' its structure. Finally, the existence of a transport model for the study area means that most effort can be expended on the land use impact model.

The land use model will be interactive with the transport model, and will be able to represent the full range of impacts from transport policy, i.e. first round effects (changes in travel behaviour in the transport model), second round effects (changes in location choice), and third round effects (changes in the patterns of new development). This compares to the 'indicator' model which can only represent areas of 'potential' development. The use of these models to assess planning options is discussed in the next section[3].

It is important for part 3 of the research that there is a degree of confidence associated with the models. For the transport model, views on its applications will be collected. Confidence with the land use model will be assessed via:

- Rigorous sensitivity testing and the use of ranges of models parameters where modelling experience or data is lacking.
- Independent estimation of results drawing upon a panel of experts using the Delphi technique (Dalkey 1969).
- Use of empirical data (if in existence).

Although this is a novel application of the Delphi methodology, a similar application has been made in relation to the Sheffield Supertram impacts on development, (Kahn 1993). The sample for the Delphi method will be both selected academics from several countries, plus local area experts, including planners and estate agents. Many of this sample have already agreed to participate in the study. The essence of the Delphi approach is to use questionnaires to obtain estimates for various ranges of response. The results are then collated and summary statistics about the range of results presented in subsequent questionnaires, with the respondents asked to re-evaluate their results if they wish. The land use model (range of) estimates will be compared to the Delphi research findings.

4.3 MODELS IN THE PLANNING PROCESS: CONTRIBUTION TO STRATEGIC PLANNING

The models will be used to produce forecasts for land use change resulting from several different transport strategies. The strategies initially selected to be tested[4] are:

1 - a do-minimum (as defined in the JIF Final Report, The MVA Consultancy 1994)
2 - the implementation of parking controls within the city centre.
3 - road pricing cordon within the city centre with a variety of charging structures.
4 - existence and non existence of the planned Lothian LRT route.

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[2]It must be stressed that the development of this model is NOT the main focus of this research, although its ease of construction and application is relevant to the objectives in determining it's 'usefulness'.
[3]It is important to note that the involved consultancies intend to market the models following this research, and it must be ensured that any commercial use of the model does not conflict with this project.
[4]Please note that the strategies to be tested is a provisional list only, and may be subject to change for technical or other reasons.

5 - strategy combinations of the above, plus other measure in the final JIF strategies.

For each transport strategy the estimates of land use response will vary by (1) the calibrated parameters in the model (referred to as 'modelling confidence range'), (2) the land use scenario selected (i.e. assumptions concerning economic and demographic trends), and (3) the effectiveness of the policies themselves.

A method of presentation of the model predictions will be developed and presented to the case study authorities via interviews. The format of the data, and other factors will initially be determined in interviews with experts in part 2 of the research. Assessment will be made with land use and transport planners, on various tiers of the Scottish national and regional government (or the appropriate strategic planning bodies at that time[5]).

The issues to be explored in the Part 3 interviews can be summarised as follows[6]:

Issues concerning transport impacts on land use:

- Given the model results, what timescales are most relevant to different types of planners?
- Do results of the kind presented contribute to structure planning? How, and in what elements of the planning process?
- Does the model assist in integrating or formalising transport impacts on land use in the strategic planning process?
- In what elements of structure planning could a model of this form be useful? In what stages of structure plan formulation could it be applied?

Issues concerning the models:

- Are the assumptions that are built into the models seen to be valid? This includes assumptions made about the effectiveness of land use policy, the extent of the construction industry, and the demographic estimates.
- How confident are the planners that the results are valid?
- Are the ranges of land use response given by the model seen as appropriate to planning requirements?

Model Comparisons:

- Are the results given by the simple model sufficient, or is the detail provided by the interactive model of sufficient benefit to justify its increased cost?
- The spatial extent and zoning of the models is the same. Is this appropriate to strategic planning?

Clearly the design of the data presentation, and the structure of the interview (as well as the sample selected), is imported if the results are to be representative. The sample will consist of numerous planners, both to control individual bias, and to determine in which areas of planning the modelling process can offer benefits. It is also feasible that interviews will be carried out with another county council (using the same results for Lothian) for comparative purposes and for assessment of the form of the output itself.

[5]This is a possible area of follow up research, comparing the attitudes of planners in the existing planning structure with those once a Unitary Authority structure has been imposed.

[6]This list is to be developed over the next three months

5 SUMMARY RESULTS OF FIRST ROUND INTERVIEW RESEARCH

This section summarises the main results from the first round of interview research carried out as part of this project. It begins by summarising the results of a survey of recent policy advice notes, recommendations and publications, and then presents the survey findings, drawing implications for the remainder of the research.

5.1 REVIEW OF POLICY DOCUMENTS

A series of policy documents were examined which referred to the impacts of transport on land use, or were 'expected' to do so by nature of their content. These included documents from *central government*, for example Planning Policy Guidance notes, Regional Advice notes, and the Sustainable Development Strategy. Reports *to* central government, for example the report from the Royal Commission on Environmental Pollution and the 1994 SACTRA report on road infrastructure appraisal. *Regional or planning association* reports were examined, for example the SERPLAN report on transport and economic development, the LPAC 'Advice' for London Boroughs. Finally, a sample of *local authority* development plans were examined, for Lothian Region, Surrey, Avon, Leeds, and Bedfordshire. The review has concluded the following to date[7]:

- There is no recent policy history of examining transport impacts on land use as standard practice in structure planning or transport policy appraisal.

- The current focus (with regard to land use and transport interaction), both from central government, and in local authorities, is on how to influence travel using land use instruments (such as PPG13), with little emphasis on how transport systems influence land use in the long term. This rather one-sided approach can be initially explained by recent environmental pressures for the government to take action on rising car use[8], coupled with the fact that the impacts of land use on transport are more amenable to study and policy interpretation[9].

- The documentation indicates that there has been very little study of how transport policy impacts on urban land use patterns, or whether the impacts cause developments that impinge upon and/or contradict the written statements of structure plans.

- Nevertheless, impacts on land use are being stated as an issue of increasing importance, due to (1); the move back to a plan led system, where understandings of interactions between system components are vital for co-ordinated and robust[10] planning, (2); proposals for policies that may have major impacts on the vitality of urban centres; notably parking and road pricing policies, and (3); re-newed study of existing appraisal techniques that reveal inconsistencies in certain cases if land use impacts are ignored.

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[7]New policy documents will be added as they are published

[8]PPG13 is an example of recent Government guidance where efforts to reduce car travel are aimed at reducing UK CO_2 emissions.

[9]Clear links are recognised between land use and transport generation. However, there is little empirical evidence that increasing 'choice' will reduce car use. The ECOTEC report uses phases such as 'policies most pertinent' to reduce travel demand (DoE, 1993, page viii) and the study is based upon circumstantial evidence on patterns of urban form and energy use.

[10]Co-ordinated: as between the different elements of the plan: namely economic development, land use planning and transport. Robust: meaning that the general statements in the plan take account of how interactions occur, and is designed to withstand (if desired) market processes and pressures.

5.2 INTERVIEWS WITH PLANNERS AND ACADEMICS

The above discussion of current policy revealed consistency between the different planning hierarchies. It is useful to translate the key theme from this into a hypothesis[11] which is also a tentative conclusion drawn from an examination of the policy documents:

There is no common practice of assessing transport impacts upon land use in the UK, despite the existence of appropriate methods. Lack of data, a belief that the impacts are of minor importance only, plus an alternative emphasis on how land use can influence transport demand has restricted interest in transport impacts upon land use.

It was realised at an early stage that this hypothesis could not be satisfactorily tested from published literature alone, and in-depth professional opinion needed to be sought. For this purpose the hypothesis can be translated into a series of questions as follows:

1. To what extent are transport impacts on land use *currently examined* and the results used in structure planning?
2. Why does there seem to be this *gap* in the policy documents with regard to assessing and drawing policy from transport impacts upon land use?
3. What *methodologies* are used, or sources of evidence utilised?
4. What *kinds of impacts* are most relevant for structure planning?
5. How *significant* are transport impacts on land use in the current planning context?
6. What is the state of the *working relationship* between land use and transport planning departments?
7. In addition, questions were asked specifically on the merits of computer modelling of land use response.

These questions were presented to a sample of planners via face to face interviews[12]. The sample was selected according to the following criteria:

- To obtain a 'representative' sample, several different planning authorities needed to be interviewed, on a range of spatial scales, encapsulating the 'tiers' of planning whose documents were discussed in the previous section. This therefore includes civil servants in central government, planners on the regional committees, and planners with county councils/regions. District councils were omitted due to the local rather than strategic nature of their planning work.
- As 'cutting edge' practice was sought, it was decided to target authorities who had published integrated strategies, or were known to be involved in land use and transportation studies (from press reports or published papers).
- Finally, to balance professional planners opinions, interviews were sought with a range of 'experts', both academics and consultants.

The list of interviews is presented in table 1. Note that column 3 outlines which questions were discussed with the interviewee.

The summary results of these interviews are as follows;

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[11]This research falls into a positivist epistemology. Therefore, a hypothesis should be defined as a general provisional statement that is not yet accepted as true.

[12]Full discussion of the selection of the methodology and rationale of the sample has not been included in this working paper.

- The issue of transport impacts on land use is not currently subject to meticulous study. However, it is of increasing interest to the majority of planners interviewed, and they believed that this was a widely held view within the profession (although it should be borne in mind that the sample was biased towards those involved in integrated transport strategies).

- When asked to explain why this gap occurred, reasons were given that (1); transport schemes or policies have been generally assessed on transport criteria (2); the relationships are not well understood beyond simple relationships from intuitive reasoning, (3); the effects are difficult to observe (i.e. occur over a long time scale), and (4); many other factors affect development, not just transport impacts.

Table 1: Organisations Interviewed

Scale	Organisation	Topics Discussed
Central Government	Department of Transport	1,2,3,4,5,7
	Department of Environment	1,2,3,4,5,7
	Scottish Office Industry Department*	1,3,4,5,6,7
	Scottish Office Environment Department	(to be interviewed)
Strategic Organisations	London Planning Advisory Committee	1,2,3,4,5,7
	South East Regional Planning Conference	1,2,3,4,5,7
Local Authority Planners	Lothian Regional Council	1,2,3,4,5,6,7,
	Surrey County Council	1,2, 4,5,6,7
	Bedfordshire County Council	1,2,3,4,5,6,7,
	Merseyside Information Service	1,3
	Avon County Council	1,2,3,4,5,6,7
University Academics	University of London: University College; and, Centre for Transport Studies	1,2,3,4,5,7 7
	University of Cambridge, Department of Geography	1,2,3,4,5,7
	University of Leeds, Department of Geography	1,3,7
	Oxford Brookes University, School of Planning	3, 7
Consultancies	The MVA Consultancy	1,3,7,8
	Marcial Echenique & Partners	(to be interviewed)
	GMAP	1, 3, 5,7
	Environmental Resources Management	1,2,3,5, 7

[*results not yet included in this report]

- When asked how important the relationship was perceived to be, the comments generally accorded with those presented in policy documents (Section 5.1 bullet 4). However, there were also three additional points; (1) that the relationship is not so important for policy making because the effects can be controlled by the powers of the planning system; (2) that in the context of other local authority objectives, it was less important than actually determining the transport implications of, for example, demand management; and (3) that for councils not wanting to encourage further land use development it was of less importance.

- The planner's perception was that most assessment at present is done on the basis of ad hoc knowledge, common sense and experience. The main formal method of analysis was the use of MEPLAN, although planners knew about modelling work at Leeds, London and the also the Lowry model. It was also an expressed view that future studies of impacts would need to comprise several different methods, for example modelling in conjunction with

interviews or some empirical analysis. There is a general (though not unanimous) perception that modelling is not particularly robust, and cannot adequately represent the complex land use / transport relationships for predictive purposes.

- The current policies for which impacts on land use would be useful are city centre parking and road pricing policies, which were also generally acknowledged to be the hardest to predict.

- It is certainly not the case that land use and transport planners never talk to each other. The sample of local authorities all had cross fertilisation of ideas and joint committees. However, everyone in the sample, from central government to local authorities, expressed the need for closer co-operation.

- Despite reservations, computer modelling of land use and transport was seen as the major way of estimating impacts into the future for specific locations. The scepticism focuses around;
  - the perception that the processes over time or across space are not well understood;
  - the empirical data to calibrate the models is always inadequate;
  - the separation of transport from other factors in location choice is seen as artificial;
  - the model results are treated as 'the answer' by laymen, and;
  - models are an expensive use of resources given the lack of certainty about the results.

  The fundamental doubt however, especially among land use planners, was whether modelling is appropriate (due to its failings) for the policy questions at present.

- Complexities of this topic area (for example spatial scale for study on the strategic level), are recognised by most of those interviewed.

- The emphasis is upon consultants and academics to develop methods for this area.

- There is a large discrepancy between accessibility as commonly used by local authority planners, and the indices used in models. The latter are perceived as abstract and difficult to understand. It is also generally difficult to obtain accessibility data over time. For these reasons the local authorities interviewed generally did not have formal or standard measures for accessibility, and where it was used, it was generally as a tool for guiding public transport operations.

5.3 CONCLUSIONS AND IMPLICATIONS FOR THE RESEARCH PROJECT

From the above study, it can be concluded that there has been very little study of transport impacts on land use at the local authority (and structure plan) level. It is certainly rare for land use responses to be formally examined, and if so, is more likely to be a 'one off' study, rather than internalised into the plan development process. This is in comparison to land use development impact on the transport system, for which studies are commonplace.

However, there is clearly a need to incorporate land use response into the planning process. This is due to the long term nature of environmental targets, and the need for better integration of land use and transport planning (and planning departments). Concerns for 'sustainable' urban form over the long term require long term perspectives in planning. In addition, it is debatable whether the planning development control and zoning powers really do control all unwanted land use responses, and this is an issue which requires further examination.

The implications for focusing the remainder of the research are manifold. Firstly, most planners are aware of formal modelling approaches to modelling land use response. What seems to be required is not more models *per se*, but a better understanding of where the model fits into the

planning process, and what the requirements of the planners are, in terms of detail and reliability of the predictions. Ultimately it is this which determines how 'useful' a model is.

The view was expressed that although planners believe that transport innovations mould urban form over the long term, most of their priorities are concerned with the short and medium term developments and policies. This research should not aim to prove them wrong, but to isolate those transport policies, circumstances and objectives where longer term objectives are important to current planning practice.

It is also realised that much of the technical work in this field is undertaken by consultants (who may themselves have planning experience), while the 'clients' and policy formulators are local authority planners. This research is therefore focusing at the interface between client and consultant.

Analysis of the interview work implies that the following questions should be addressed:

- Whether models are appropriate (for planner's use) to estimate the land use response.
- If so, what kind of model, and how detailed, is the most efficient balance of output versus cost.
- Whether the outcome of land use response is indeed a data gap that needs to be internalised into the planning process, or whether even with models, the predictions are insignificant or unimportant.

It is intended that this project will contribute to this rapidly burgeoning research field by assessing planning forecasting requirements in conjunction with model development and methodology formulation.

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APPENDIX : INITIAL CHAPTER STRUCTURE

Part	Chapter	
I	1	**Introduction** The nature of planning; the nature of transport impacts on land use; the structure of the thesis
	2	**The Policy Context** A summary of policy involving transport impacts on land use and recent policy statements. Results from the initial first round of interviews with planners and academics.
	3	**Empirical and other Sources of Evidence** Empirical evidence: PT urban studies, urban road infrastructure. Behavioural studies and Management Science.
	4	**Theory and Methods of Evaluation and Prediction** The concept of Accessibility, Location theory, Models of choice, Calibration. Past modelling studies, ISGLUTI, use in practical planning contexts.
II	5	**A model of transport impacts on land use** The Structure of DSCMOD+ and its relationship to the START model. Critical comparison to other land use and transport models.
	6	**Application of the model to the case study region: Lothian** Data collection from the study area. Problems with data. Models of household transition and employment change, relocation processes, construction processes.
	7	**Capturing the range of effect: the Delphi and other techniques** Sensitivity Tests, Methodology for the Delphi experiment, Results and implications for the models predictions.
III	8	**The policy tests and design of the interview assessments** Design of the interviews, sample selections, results.
	9	**Evaluation and Discussion** - the success of the methods of obtaining data on land use response (towards a framework for understanding transport impacts on land use). - the success of the modelling - the attitudes of planners towards modelling land use response. A critical assessment of evaluation technique. - Use of the interviews: models in the planning process.
	10	**Summary and Conclusions**