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Overcoming barriers to model use

Simon Shepherd[1], Andrew Koh[1], Chandra Balijepalli[1], Ronghui Liu[1], Pauli Pfaffenbichler[2], Guenter Emberger[2], Andrew Ash[3].

[1]Institute for Transport Studies, University of Leeds, Leeds, UK.
[2]Technical University of Vienna, Austria.
[3]Transport Research Laboratory (TRL), Crowthorne, UK.

Corresponding Author : S.P.Shepherd@its.leeds.ac.uk

Abstract
Research has shown that most local authorities do not use models in strategy formulation or scheme design and that others who do are doubtful of their value. This paper reports on a study aimed at enhancing analytical planning tools. Firstly, barriers to modelling of policy instruments were assessed by survey and literature review. From this themes for improving the modelling of demand restraint and public transport instruments were identified as areas of main concern along with ease of use and transparency of approach. Enhancements are reported for a range of existing models including strategic, macroscopic and micro-simulation techniques. Although these are demonstrated for specific software applications the methods are transferable to other models. Finally we consider to what extent the barriers have been addressed.

Key words : transport modelling, transport policy

1. Introduction

This paper is one of a series on a UK research programme, DISTILLATE (Design and Implementation Support Tools for Integrated Local Land use, Transport and the Environment), which carried out research into six barriers deemed of particular importance to UK local authorities, and developed a series of products designed to support local authorities in their decision-making. The DISTILLATE research programme was funded under the UK Engineering and Physical Sciences Research Council's Sustainable Urban Environment initiative, which placed a particular emphasis on research which met the needs of practitioners. It also sought research proposals which were multi-disciplinary, reflecting the complex nature of the problems to be tackled, and multi-institutional, given a concern that no one institution might have the critical mass of research skills needed.

The DISTILLATE programme responded to these challenges by involving local authorities and related actors directly in the research programme and by bringing together the research skills of two interdisciplinary transport research groups, a planning school, a policy-oriented research centre, and a national research establishment. It was designed to help overcome those barriers to decision-making which were judged to be most serious, and most amenable to research-led solutions. It set itself a vision of helping to achieve a step change in the way in which sustainable urban transport and land use strategies are developed and delivered. Further details of the programme as a whole, and of the role of the project reported in this paper, are provided in the overview paper (May, 2009).

Research on behalf of the Department for Transport (DfT) and the European Commission (EC) (Shepherd et al, 2006a, Simmonds et al, 2001, Martens et al, 2002, Wegener and Grieving, 2001) have indicated that a substantial proportion of local authorities do not use models as an aid to strategy formulation or scheme design and appraisal, and that others who do are doubtful of their value. This situation has arisen for a number of reasons. Most models are unable to adequately reflect the range of policy instruments which local authorities are now encouraged to use. In addition, model predictions often appear unreliable and the models are frequently too complex for local authority staff and stakeholders to use themselves. As a result, models are typically run by consultants and treated as black boxes by local authorities.

As a response to this we focussed within the DISTILLATE project framework (May, 2009) on three themes: the lack of coverage of policy instruments, the need to enable the wider and more effective use of models and the need for enhanced strategy generation tools.

The overall aim was to increase the effectiveness and relevance of existing predictive transport and land use models so that their use would be more attractive to local authorities and other stakeholders. Within this overall objective, the project developed through its scoping study (May et al, 2004) the following specific objectives:

- to identify those policy instruments which could most usefully be incorporated into existing models and to develop and test ways of doing so

- to enhance existing sketch planning models so that they can be used more effectively and interactively by a wider range of stakeholders
- to develop our sketch planning models and network management design tools as pilot strategy and scheme generation tools.

The first objective was approached by means of an initial survey of local authorities and, as explained below, the results identified general areas of concern regarding model capabilities and use rather than providing an exhaustive list of instruments to be incorporated into existing models. We responded to the results of this survey by modifying our research strategy and re-structuring it around the themes identified from the survey rather than any instruments identified.

The remainder of the paper is in four sections. Section 2 discusses the results from the survey of local authorities on modelling and barriers to modelling. It also highlights some of the more technical barriers as revealed by a detailed literature review. Section 3 presents three approaches to improving the modelling of demand restraint measures while Section 4 reports on improved public transport modelling. Section 5 describes developments made to TRL's Strategic Transport Model (STM) and the strategic model MARS while Section 6 reflects on whether the barriers have been removed and points towards further research.

2. Identifying Modelling needs and barriers

2.1 The local authority survey

The first stage of the DISTILLATE project involved surveying the 16 local authority partners (Hull, 2009). The aim of the survey was to interrogate local authorities on the importance they attached to the modelling of different proposed interventions, and their perceived abilities and/or barriers in doing so. For full details see DISTILLATE (2005), Hull and Tricker (2005).

The most useful answers (apart from the individual text box answers) came from the importance and satisfaction questions where the respondents were asked to rate the level of importance and their satisfaction with current modelling capabilities for a range of policy instrument types and enabling factors.

Figure 1 summarises the importance and satisfaction given to modelling certain types of policy instrument. In general Light Rapid Transit (LRT), land use measures, road infrastructure, traffic restraint and improvements to bus services were seen to be most important while slow modes, information provision, traffic management and soft measures such as awareness campaigns were seen to be less important in terms of modelling.

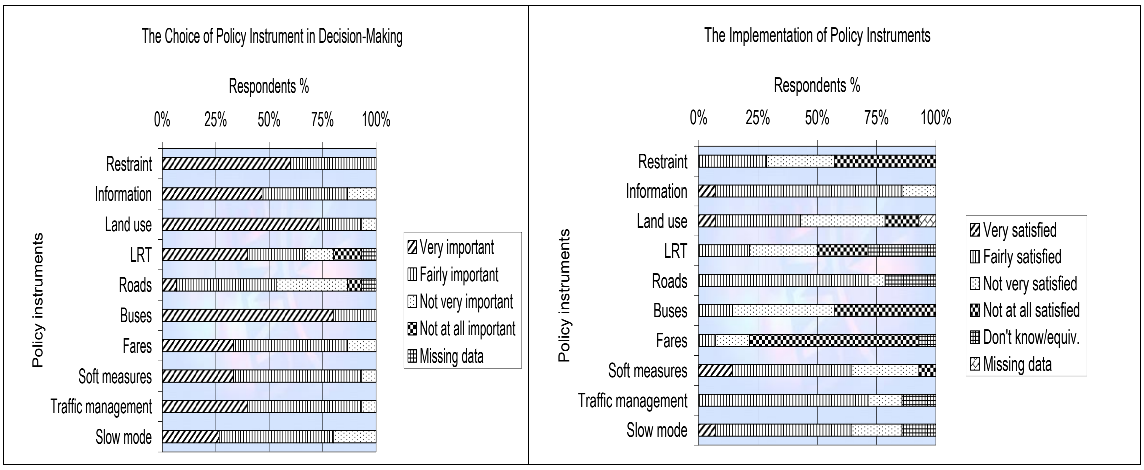

Figure 1: The importance and satisfaction of modelling specific types of instruments.

In general most authorities were satisfied with the modelling of LRT, new road infrastructure and traffic management and to some extent land use measures. The level of satisfaction for other measures depended partly on the measure being considered and on the experience of models used by each local authority.

Table 1 shows the Seriousness Score for modelling of each policy instrument, calculated as the product of the importance and satisfaction scores from each respondent (see DISTILLATE (2005)). A higher score implies that the instrument type is both more important and has more room for improvement. The scores provide a ranking of modelling barriers by instrument type.

Ranking of Modelling issues	Seriousness Score (0-1)	Ranking
Restraint	0.58	1
Fares	0.55	2
Buses	0.53	3
Land use	0.53	4
LRT	0.47	5
Soft measures	0.43	6
Slow mode	0.42	7
Roads	0.41	8
Traffic management	0.36	9
Information	0.34	10

Table 1: Ranking of modelling issues and enabling factors.
Note: The neutral score is 0.3275. Higher scores indicate a barrier. Score 1.0 would indicate Very important and not at all satisfied for all respondents

From the above ranking and more detailed analysis of the questionnaires it was decided that the research should look at the following modelling themes :-

1. Demand restraint measures (e.g. parking charges/capacity, road user charging)
2. Public transport improvements (quality bus corridors, capacity, bus priorities)
3. Land use measures (development controls)
4. Soft measures (attitudinal, awareness campaigns)
5. Slow modes and small scheme impacts (cycling and walking strategies)

and more general issues

6. Data issues
7. Model use.

2.2 More specific barriers

Apart from the user survey we also conducted a desk based study of the literature to identify further gaps in modelling methodology (Shepherd et al, 2006b). The aim of the review work was to look at the current state of the art and current practice in terms of modelling and compare to an idealised modelling framework thus identifying gaps or possible areas for model enhancements. This was possible for the first two themes where there is a history of model use for analysing demand restraint measures and public transport; however for land use measures and attitudinal measures a slightly different approach was adopted whereby evidence of impacts was sought from field trials.

The review of demand restraint measures concentrated on the modelling of road user charging schemes considering the following issues

- the conventional modelling methodology based on the four stage model
- the various road user charging schemes which require modelling
- the various responses to tolls that have surfaced in the literature
- recent examples of modelling from overseas and in the UK
- an improved modelling framework and implications of using the recently issued variable demand modelling advice.

The review then covered a wide range of public transport models covering a number of modes and purposes. In order to facilitate comparison the models were split into the following categories:

1) Rail models
2) Bus models
3) Multi-modal & Network based models.

Within each of the above public transport model categories there exist a wide range of demand based models ranging from simple static elasticity models to more complex dynamic, network based models which consider both supply and demand. The review compared the modelling approaches and identifies gaps or weaknesses within each approach by looking at how each model deals with a range of instruments split into "hard" and "soft" instruments and their impacts.

The term "hard instruments" relates to policy instruments whose effects are easily quantifiable (e.g. fares, frequencies, new stations, bus priorities) and for which well established relations with supply and demand are known. Public transport fare and service elasticities have been well researched and a series of empirical studies, based on both revealed and stated preference studies, has established accepted values. Similar research has been carried out for private car use and also for cross elasticity effects between the two (TRL, 2004).

Less is known about 'soft instruments' which introduce changes in other elements which make up the experience of travelling, e.g. better information, security, comfort, cleanliness, awareness etc. It is much harder to measure the impacts of such instruments, since they remain subjective to the traveller. Measuring the value placed upon impacts such as 'personal security' or 'cleanliness' has relied on the use of stated preference techniques and the values are less well accepted in comparison to 'hard values' such as values of time. These values are however being seen as increasingly important by transport practitioners as they try to complete the picture on how travellers react to non-conventional public transport, i.e. rapid bus transport, park and ride, new information services etc.

The review identified 14 detailed barriers to modelling demand restraint measures and 17 related to public transport modelling. Within this paper we concentrate on the following barriers (taken from Shepherd et al, (2006b) but re-numbered here for ease of presentation) as these are the ones which we focussed on overcoming with our existing models.

Demand restraint issues

D1. **Area based charging schemes**
Modelling response per day or tour rather than per trip is the issue here. Whilst some models can deal with tours most assignment models do not.

D2. **Modelling of exemptions or discounts**
Exemptions for residents – the problem here is matching data to trips in the assignment. Exemptions by vehicle type or occupancy level are normally dealt with by applying factors outside the modelling of responses.

D3. **Car park capacity and choice**

Modelling car park capacity and impact on car park choice was identified as a gap by local authorities in the initial survey.

D4. **Scheme design**

Finally although not a modelling gap, there is a gap in methods for scheme design.

Public transport issues

PT1. Explicit representation of the capacity of buses and the impact of capacity on route choice

PT2. Inclusion of demand in response to soft variables associated with quality bus routes.

PT3. Improved specification of supply functions for new public transport infrastructure and modes such as heavy rail, quality bus routes, park and ride and BRT.

Associated with public transport was also the need to model the impact of marketing campaigns.

Ease of use and transparency

U1. Other issues which arose from the survey identified weaknesses in current approaches to target setting, option generation, ease of model use and transparency of the model itself.

To some extent we had already identified these weaknesses within the scoping study and we anticipated covering these issues with the inclusion of the second and third sub-objectives of this project, namely to

- Enhance existing sketch planning models so that they can be used more effectively and interactively by a wider range of stakeholders
- Develop our sketch planning models and network management design tools as pilot strategy and scheme generation tools.

In response to the above barriers and weaknesses we set out to enhance our existing models and develop certain aspects of the methodology whilst ensuring the methodologies remained transferable to other model platforms. The following sections demonstrate how we have contributed to overcoming some of the key barriers through application of case studies. Section 3 looks at overcoming barriers related to demand restraint, section 4 looks at public transport issues while section 5 covers model usability and transparency within a strategic modelling framework.

3. Improved modelling of demand restraint

Three separate methodologies covering barriers D1-D4 above were developed and demonstrated through application in SATURN (Van Vliet, 1982). The first is an approach to aid the design of road pricing cordons, in particular their location, the second demonstrates how to implement area based area based charges rather than cordon charges while the third integrates the choice of parking within a traditional assignment model. Although the enhancements are described and implemented for SATURN they should be easily transferable to other assignment packages.

3.1 A short-cut approach to cordon design

The short cut approach to locating a reasonable cordon was developed from an observation that charging on only a few of the highest marginal cost links could result in a high proportion of the system optimum or first best benefits. Initial results on various networks have shown that the approach can double benefits compared to a judgemental cordon and more impressively achieve more than 90% of the benefits obtained by more complex time consuming optimisation approaches with only a few model runs (see Shepherd et al, 2008).

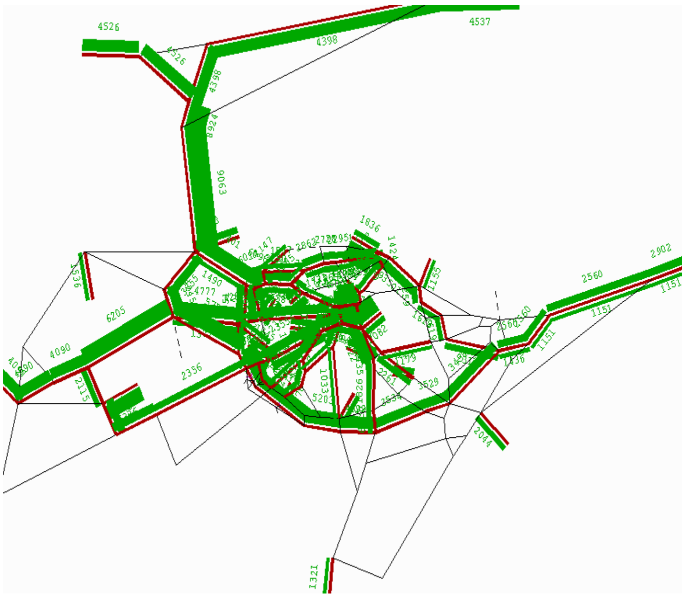

Figure 2 : Example of select link analysis for cordon design

The process is simple to apply and relies on first of all being able to identify the high cost links and second being able to plot where the flows through these high cost links come from or go to on the network as shown in Figure 2.

Once such a plot has been produced it is simply a case of designing a cordon which “catches” a significant proportion of these “high cost” flows somewhere along their journey. This is usually done visually and so involves the planner directly allowing them to take account of other political or sensitive issues. For more information see Shepherd et al, (2007, 2008).

3.2 How to implement area-based charging

Traditionally, modelling a city centre charging cordon involves drawing a cordon around the city centre and adding the charges on a per trip basis to the links crossing the cordon line. However with area based charging it is also necessary to charge those who travel within the area and to allow for multiple cordon crossings.

Although the method is demonstrated using a SATURN model it should be feasible to implement the approach in other models. In SATURN it involves charging those within the area by adding a charge directly onto the centroid connectors (which was not previously possible). This simple concept allows an area based charge to be made up from a traditional cordon charge and an additional charge for those origins within the cordon. This separation of the charging elements also allows for differential charging to be tested where residents may be given an effective discount.

Initial results show that area based charging can increase the benefits for a given cordon design by charging those who live within the area a lower fee than the cordon fee itself. In the example in Figure 3, the highest benefits arise for a cordon charge of 225p and an area charge of 75p with benefits some 30% higher than for the cordon only optimum. For more details see Balijepalli et al (2008a).

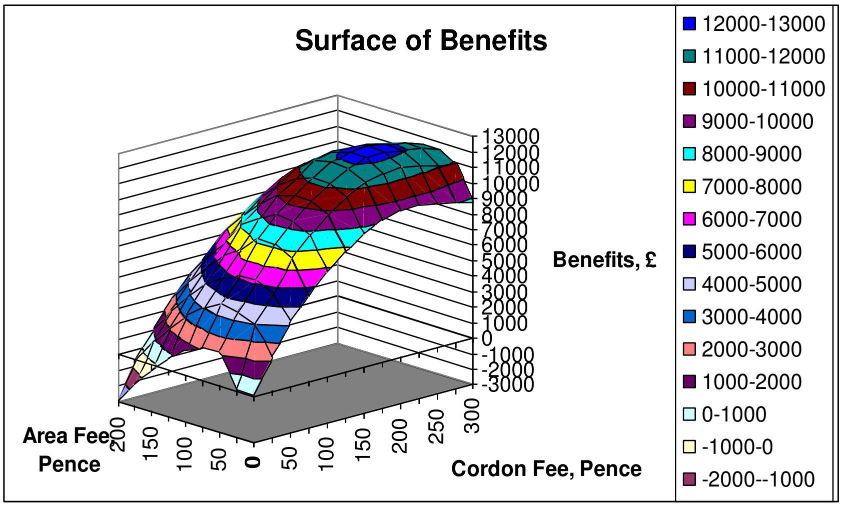

Figure 3 : Benefits as cordon and area fee are varied.

3.3 Modelling the choice of car parks

Car parks are an essential piece of infrastructure associated with road networks, yet commonly available traffic assignment models do not explicitly integrate them into the modelling process. The choice of car park depends on cost, type of car park, capacity or time spent searching for a space and distance to final destination. The approach adopted is to integrate such elements within the generalised cost of travel and so incorporate the choice of car park within the natural equilibrium framework of the assignment model.

Existing facilities within SATURN can be used to create car park links with search time dependent on the ratio of occupancy (from the previous period) to capacity and choice of car park can be enabled by adding walk links to final destinations. This allows choice of car park to be modelled as changing over time as car parks become full.

The technique has been successfully applied to study the choice of car parks in the case of a simple five link network and for a network of Leeds demonstrating the sensitivity of the results to the input car park characteristics such as capacity, search time and costs. For more details see Balijepalli et al (2008b).

4. Improved public transport modelling

In this section we report on two tools which overcome barriers PT1 and PT3 above. The first tool is an improved micro-simulation approach to modelling bus reliability using the DRACULA model. The second incorporates park and ride models for subways within a strategic model (TRL's STM).

4.1 A micro-simulation approach to modelling bus reliability

A typical framework to represent public transport operations, passenger demand and route choice, and micro-simulation of the movements of individual vehicles (cars and buses) and passengers in a road network is presented in Figure 4. The tool enables the user to evaluate public transport priority measures, management and control strategies and infrastructure changes, and to assess their effect and the effect of congestion on service performance such as reliability.

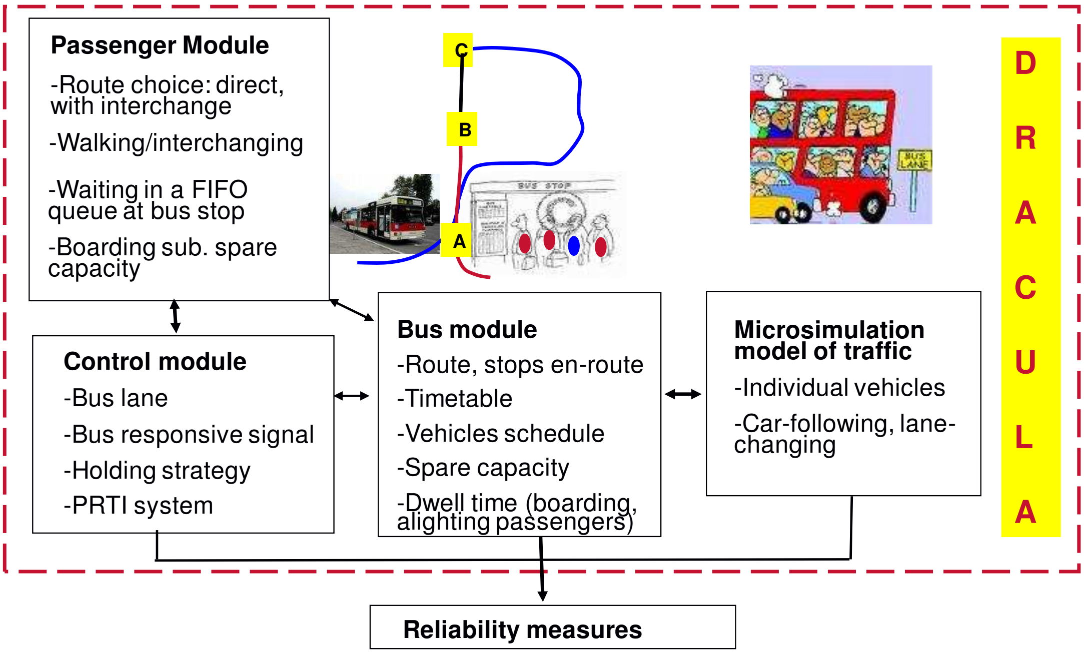

Figure 4 : A modelling framework to represent public transport operations

The model used to demonstrate the modelling framework is DRACULA and the case study involves Bus Route 4 in York. To implement the model requires basic timetable data and information on passenger demands at the relevant bus stops along the route. The method implemented within DRACULA should be transferable to other micro-simulation models. Figures 5a and 5b show the area modelled and typical outputs used to calibrate the model to observed data. For more information see Liu and Sinha (2007).

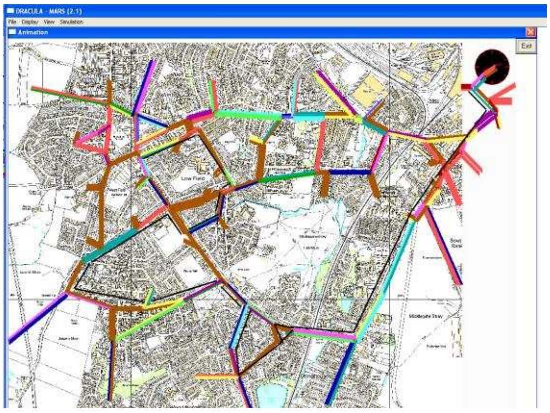

Figure 5a : York study area

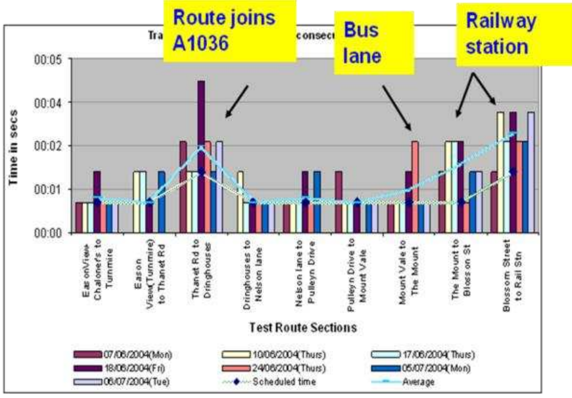

Figure 5b : Typical calibration outputs

4.2 Mode-chain modelling in Strathclyde using TRL's Strategic Transport Model

The object of the case study was the development of a 'mode chain' modelling facility within a strategic transport model for Strathclyde; this would permit travellers to interchange between different travel modes in the course of a trip rather than use only a single, main mode. The computer software development for this has been limited on practical grounds to developing this feature for park and ride at stations on the Glasgow Subway (underground).

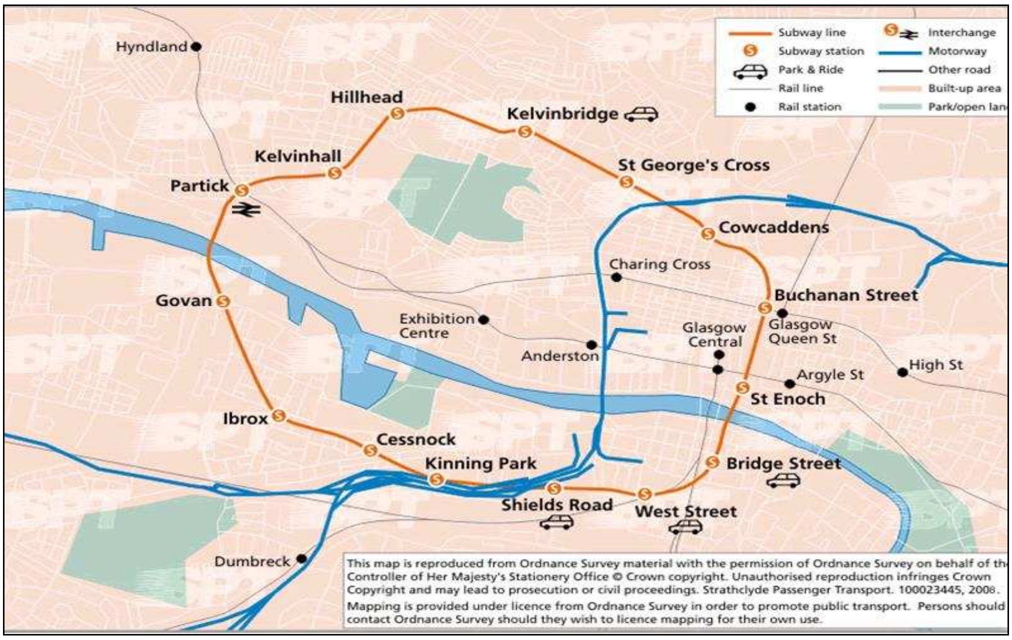

Figure 6: The Glasgow Subway System (Source: SPT)

Modelling of park and ride is not, of course, something new. The modelling here is however innovatory in that:

- It sought to produce a realistic treatment of mode chaining within a 'sketch' strategic transport model lacking a network assignment model. Mode chaining is a complicated travel process, hence its implementation in a sketch model represents a real challenge.

- It confronted head-on the difficulty of obtaining travel information for the base case by incorporating suitably constrained synthetic techniques within the transport model. This greatly enhances the economy of the model.

- It used a comprehensive integrated approach to park and ride and parking in the City Centre.

The model represents the possibility of park-and-ride travel from all stations on the Subway and simultaneously models the interaction between demand for

- Travel by car to the city centre and parking there
- Travel by park and ride via the Subway
- Direct travel to the City Centre by public transport or slow modes.

Parking models are applied to the Subway stations designated as park-and-ride sites and to Glasgow City Centre zones. Allowance is made for the possibility of parking in neighbouring City Centre zones and at neighbouring Subway stations as car parks become fully occupied.

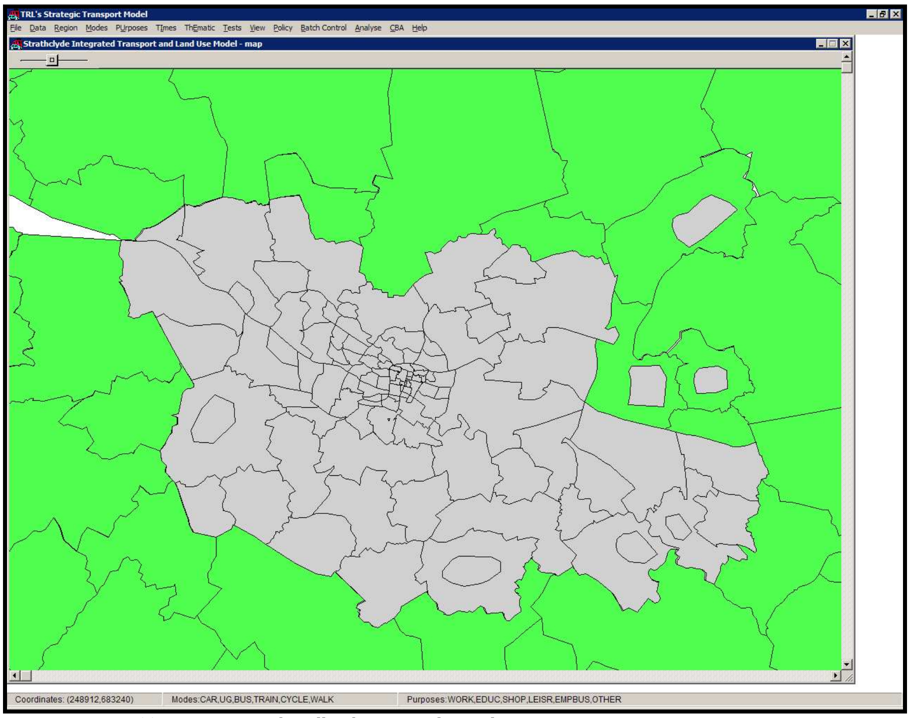

Figure 7: The Graphical User Interface of the 233 zone STM (the large grey area is the Glasgow conurbation)

The case study succeeded in creating a functioning mode chain model within a Strathclyde STM based on park-and-ride from stations of the Subway system. Example results are presented in Ash (2008a) as illustrations of the model's performance and this report concludes with a summary and suggestions for further work.

5. Providing enhanced strategic models

In response to the barrier U1 on usability, option generation and transparency of approach we have developed our existing models MARS and STM to be more user friendly, transparent and useful in terms of option generation. Although our research was necessarily restricted to using our existing models we were confident that both packages were representative of strategic models currently applied in research and practice. The following sections report on the developments for each model in turn.

5.1 Development of a Scenario Interpreter for TRL's Strategic Transport Model

The object of the case study was to develop a modelling technique which would assist interpretation of scenario outputs forecast by strategic transport models. The technique would allow users to identify the likely drivers and mechanisms responsible for model outputs under particular land-use and transport policy assumptions The study can be seen as a response to the often-justified accusation that transport models are impenetrable 'black boxes' which generate results for which no easy explanation is at hand.

A key concept in this project is that the transport model should provide appropriate diagnostic outputs which are closely linked to the underlying mechanisms within the model, thus providing a good basis for interpretation. We see this approach as ultimately leading to an "intelligent interpreter" which will automatically construct a form of narrative account of the policy test outputs based on the model mechanisms.

In Ash (2008b) a concept for a Scenario Interpreter was described and a working prototype demonstrated. The purpose of this prototype was to provide the user with an evidential basis for the interpretation of scenarios generated by the TRL Strategic Transport Model (STM). This assists users to identify the likely drivers and mechanisms responsible for model outputs under particular land-use and transport policy assumptions.

We have identified the key techniques to be employed in the interpreter; central to the method is a technique of using a first order sensitivity analysis applied in the final iterative pass of the STM (as distinct from one based on simple re-running of all the model iterations). This has the advantage of reduced run times and a clearer relationship between outputs and model mechanism. The influence of a variable on the model outputs is assessed by 'bracketing' that variable (i.e. resetting to its base value) in a special sensitivity analysis run called a 'bracket' run. The various modelling steps include:

1. Running a standard STM run to equilibrium.
2. Running the last iteration of a given standard run.
3. Applying 'bracketing' to variables in last iteration and calculating the resulting model outputs
4. Displaying a comparison of the standard run results with those of a 'bracket' run.

The STM Graphical User Interface enables the results of comparisons of different runs to be displayed (Figure 8) – this facility is used in Step 4 (see Figures 9 and 10).

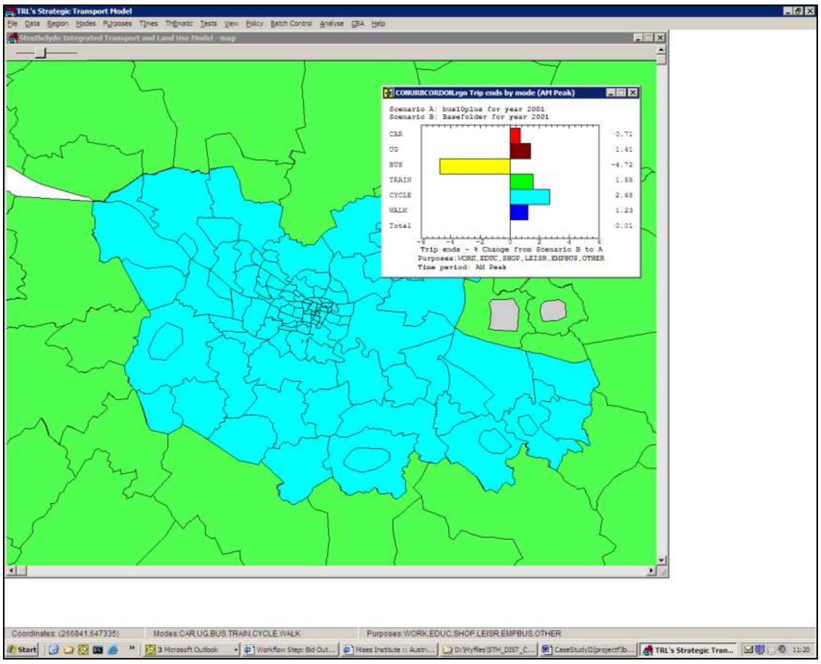

Figure 8: Screen dump showing Glasgow Conurbation and comparison between base and policy run

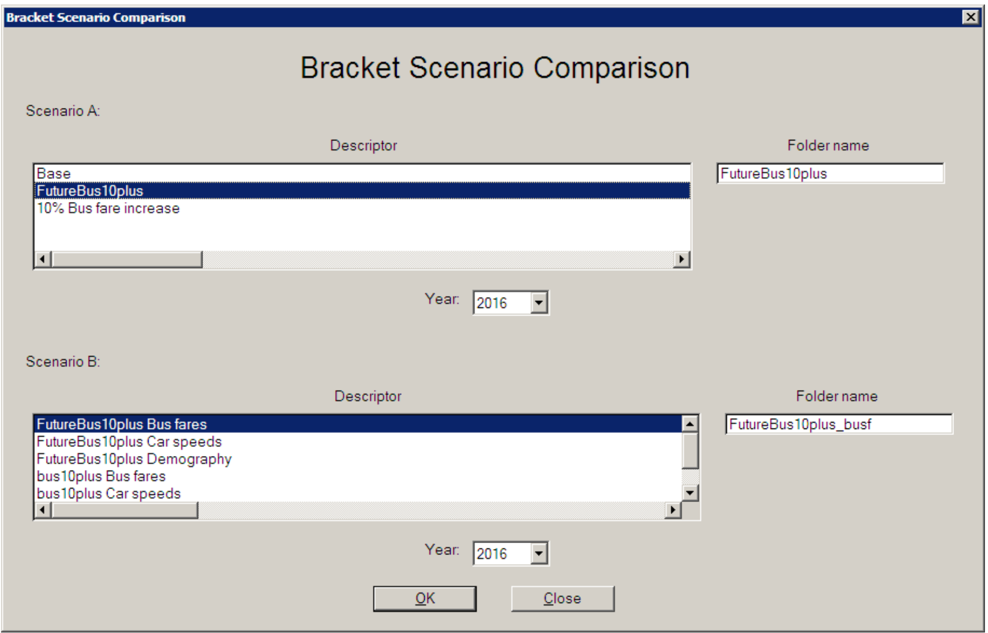

Figure 9: Scenario comparison window for bracket runs

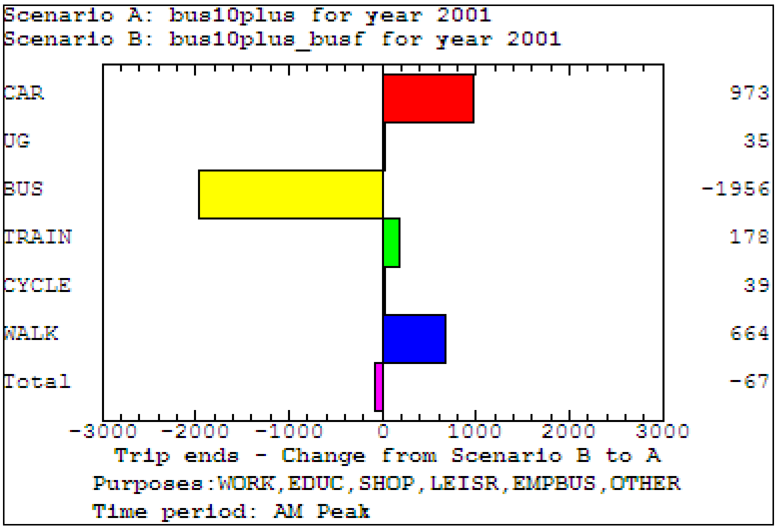

Figure 10: Absolute comparison for policy bracket run of bus fares with a standard run with 10% increase in bus fares

Ash (2008b) points to possibilities for further development of the software implementation of the model and we conclude that the technique is capable of considerable elaboration with automatic algorithms to carry out the analyses.

5.2 Developments to the MARS strategic model

This section describes the development of our strategic model MARS (Pfaffenbichler and Shepherd, 2008) in response to the barrier U1 on usability, option generation and transparency of approach. Additional model enhancements included the implementation of soft factors such as awareness campaigns, and the improved representation of supply in the off-peak and of over-crowding on public transport.

MARS is a strategic land use – transport interaction model capable of analysing policy combinations at the metropolitan level and assessing their impacts over a 30 year planning period in less than one minute. It includes a transport model which simulates the travel behaviour of the population related to their housing and workplace location, a housing development model, a household location choice model, a workplace development model, a workplace location choice model, as well as a fuel consumption and emission model. The sub-models are run iteratively over a 30 year time period. They are linked on the one hand by accessibility as output of the transport model and input into the land use model and on the other hand by the population and workplace distribution as output of the land use model and input into the transport model. A comprehensive description of MARS can be found in Pfaffenbichler (2003).

The model is built using the Causal Loop Diagram (CLD) technique to improve transparency.

Figure 11 shows the CLD for the factors which affect the number of commute trips taken by car from one zone to another. From

Figure 11 we start with loop B1 which is a balancing feedback loop. In it, commute trips by car increase as the attractiveness by car increases which in turn increases the search time for a parking space which then decreases the attractiveness of car use – hence the balancing nature of the loop. Loop B2 represents the effect of congestion – as trips by car increase speeds decrease, times increase and so attractiveness is decreased. Loop B3 show the impact on fuel costs, in our urban case as speeds increase fuel consumption is decreased – again we have a balancing feedback.

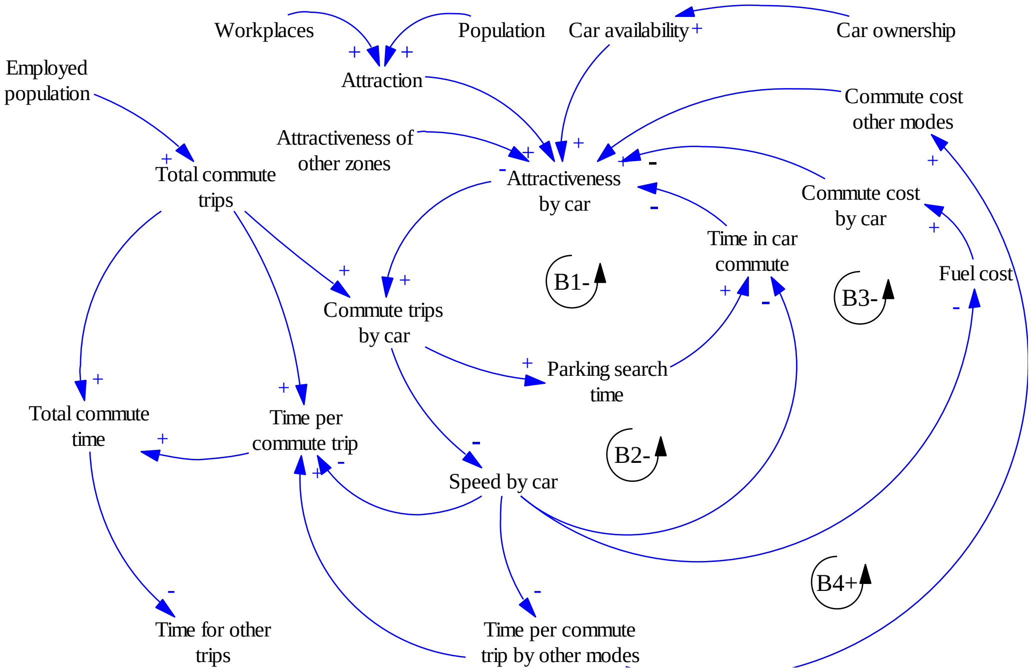

Figure 11: CLD for the transport model – commute trips by car in MARS

Apart from developing the CLD structure we also implemented enhancements to the model including representation of over-crowding, congestion in the off-peak period, representation of a fourth heavy rail mode, the impact of bus quality factors and awareness campaigns. These improvements are reported in Shepherd et al, (2007).

The other major barrier which can be overcome with MARS is that of ease and speed of use and presentation to stakeholders. The model has been transferred to a system dynamics platform VENSIM® which provides a transparent approach to model development.

We developed a so called "flight simulator" approach whereby a front-end as shown in Figure 12 is used to control the policy inputs by use of slider bars. This allows the user to test a combination of instruments and to view standard outputs (as shown in Figure 13) within less than one minute. In addition to the standard outputs the user can also animate GIS based data through a specially developed piece of software "Animap" which animates the map based information post simulation (see static view Figure 14). In addition the user may use the VENSIM® optimisation facility to optimise a package of policy instruments against a given set of objectives or targets. Here the user can set bounds on possible instruments, define an objective function or target trajectory for an outcome variable e.g. CO_2 and through the batch run optimisation procedure produce an integrated package which either maximises the objective function or meets the target trajectory. This feature was designed to aid option generation (Jones et al, 2009) and target setting (Marsden and Snell, 2009).

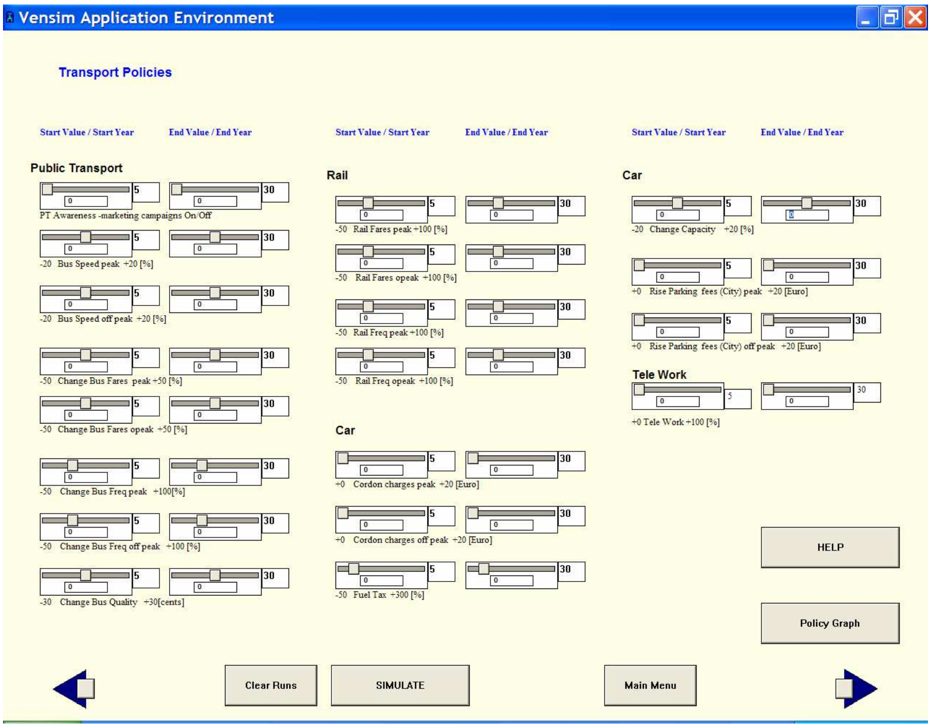

Figure 12 : Example of flight simulator front-end for MARS

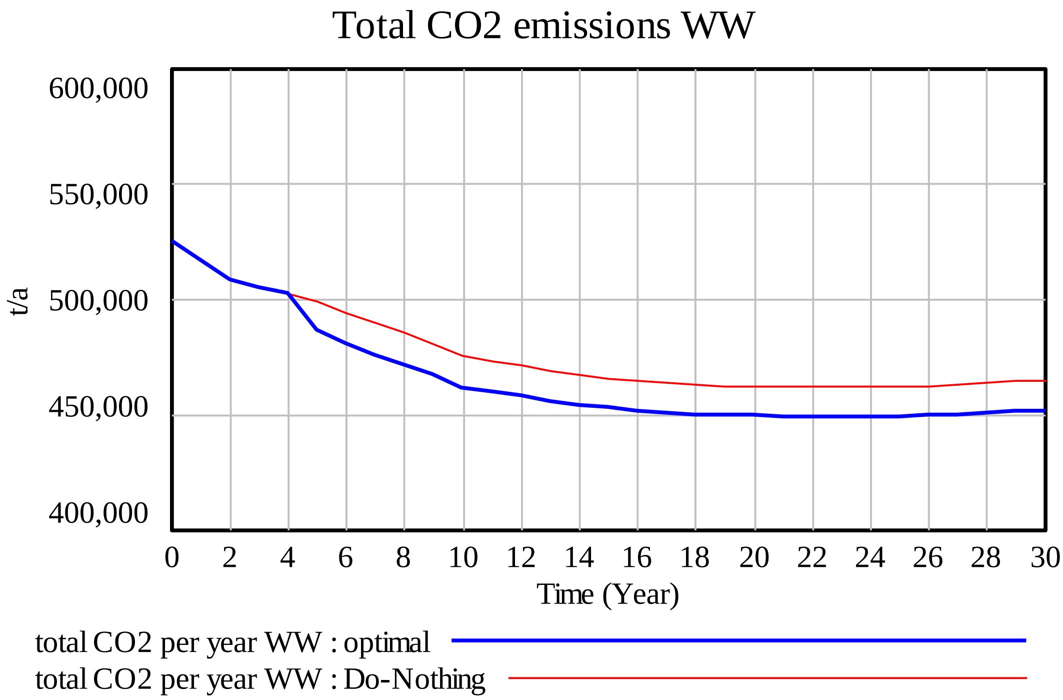

Figure 13 – Example outputs from MARS – CO_2 emissions well to wheel

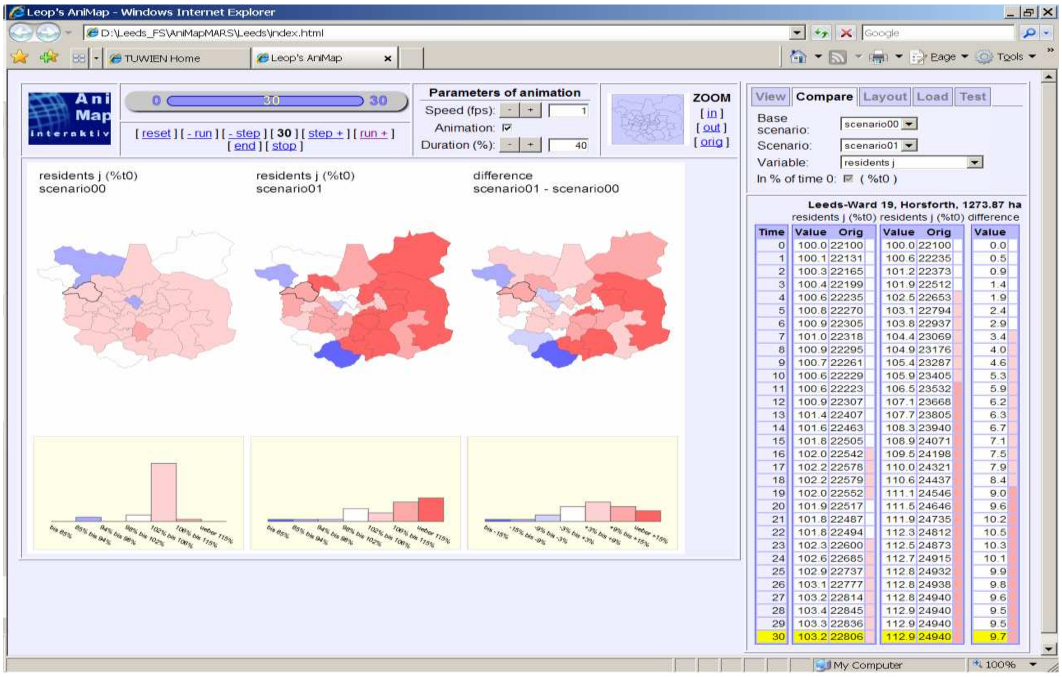

Figure 14: Screen shot from MARS-Animap animation tool.

6. Reflection and further research

The basis of the modelling work within DISTILLATE was to identify user needs for, and barriers to model use and hence to develop methodologies with almost immediate practical application. The barriers to model use were identified through a stakeholder survey with more technical methodological barriers identified from the literature.

Our research was necessarily restricted to enhancements to our own existing models and as such we concentrated on implementing changes within DRACULA, MARS, SATURN and STM. However, wherever possible we have aimed to publish the methodologies and noted how these methods can be used with other software applications.

To answer whether or not we have removed or reduced certain barriers is a difficult question and one which has been tackled by the surveys reported elsewhere (Hull, 2009). The problem with this though is that most of the tools did not come “on-line” before the final survey and as such evidence from the final survey was limited. Further work is being undertaken to monitor the impact of our work through the ISSUES project (May, 2009). However even without this information we have the following evidence of use or impact:-

1. The short cut to cordon design has been incorporated into the UK Department for Transport’s WebTAG guidance, DfT (2007) and has been successfully applied by two local authorities during the project.
2. The area based charging and parking choice methods have been demonstrated to a group of practitioners in the UK and these plus the short cut to cordon design have been made available to users via our short courses on SATURN.
3. The bus reliability work was well received by the client and the UK Department for Transport has shown interest in the approach.

4. The model enhancements to enable park and ride within the TRL STM were seen as fit for purpose by the local authority partner and the methodology established can in principle be made more generally available to STM users.
5. The method of scenario interpretation prototyped using the TRL STM has general application to other strategic models. The local authority partner has expressed interest in the use of this model extension in their future modelling analysis.
6. The MARS model has been applied to Trondheim (Norway) and Tyne and Wear (UK) as part of an EU funded project. In addition there are now firm plans to commercialise the software and an agreement has been set up in principle with a leading consultant.

In terms of future research, there are still many barriers to overcome. We have only been able to address a few of the many identified within this project. In terms of data and ease of use perhaps the most significant impact will come from models such as MARS and STM, which are particularly useful at the initial design phase or where the longer term planning horizon is seen as important. The models also provide a clear and transparent structure for presentation to stakeholders, something which is being requested more and more frequently; stakeholders do not like black-box approaches.

In general modelling needs will always change as policies come and go in the policy cycle. The modelling community has to respond quickly and is too often driven by advances in computing power rather than in real needs. The fact that a detailed micro-simulation model can be built in fine detail for a whole city may overcome some stakeholders' views about credibility, but will raise issues with other modellers and indeed raise barriers in terms of data and staffing resources required. The real skill will continue to lie in selecting the most appropriate modelling technique for the scheme or policy to be tested. Shepherd et al (2006c) sets out an assessment of English experience and recommendations for model use when developing local transport plans. However it still remains that there is a lack of transport modelling awareness, let alone skills and expertise in some local authorities and there is therefore a need to develop and present training programmes to overcome this deficiency.

Above all it should be remembered that a model is simply a model or a representation of policy performance and as such should be used to support the decision making process, not as a replacement for it.

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