A PLANNING TOOL FOR DEVELOPING TRANSPORT STRATEGY – THE DYNAMIC MODEL FOR NORTH EAST SCOTLAND

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1. INTRODUCTION

Over the last year Steer Davies Gleave has been assisting NESTRANS and its successor, North East of Scotland Transport Partnership, on the development of its Regional Transport Strategy (RTS)[1]. This paper focuses on how a model, the Dynamic Model for North East Scotland (DMfNES), was developed and used to help develop options as well as to evaluate their success in meeting the objectives of the RTS. This forms part of an innovative approach to transport planning and strategy development where we used the model in a workshop with stakeholders to develop and assess options.

In addition to reflecting on this approach to strategy development in this context, the paper will provide a description of the model framework and indicate the types of results it generates. Broadly speaking it is a simulation model, showing how events will likely change incrementally over a period of time. It uses the idea of attractiveness of zones, within the modelled area, for business activity and as places to live and estimates how transport affects that attractiveness.

2. OBJECTIVES AND APPROACH

The RTS provides an opportunity both to identify those strategic interventions that will best help to deliver the region's economic, social and environmental objectives; and to increase the pace of investment in the region's transport system. There is often tension between these objectives; and therefore trade-offs need to be made by policy makers to strike an acceptable overall balance which reflects the priorities ascribed to each of the objectives of the RTS. To achieve this, decision makers need to be able to investigate these trade-offs in an accessible way, so that the consequences of different courses of action can be compared.

In order to achieve this we developed an approach to strategy development that utilised the strengths of our Urban Dynamic Model (UDM) framework, a version of which was developed specifically for the North East of Scotland during the early stages of the project.

The primary focus of the model was to assist in the identification and testing of strategic interventions that will best help to deliver the RTS's objectives. To this end the model was used to assess the impacts of the RTS options against its objectives through the use of a number of measurable indicators.

An initial set of 6 different packages of complementary measures and activities were developed in consultation with NESTRANS which each had a slightly different focus in terms of the balance of the objectives of the RTS. These objectives were:

- To make the movement of goods and people within the north east and to/from the area more efficient and reliable,
- To improve the range and quality of transport to/from the north east to key business destinations,
- To improve connectivity within the north east, particularly between residential and employment areas,
- To enhance travel opportunities and achieve sustained cost and quality advantages for public transport relative to the car,
- To reduce the number and severity of traffic related accidents and improve personal safety and security for all users of transport,
- To achieve increased use of active travel and improve air quality as part of wider strategies to improve the health of north east residents,
- To reduce the proportion of journeys made by cars and especially by single occupant cars,
- To achieve targets for reductions in the environmental impacts of transport, set out in the National Transport Strategy,
- To reduce growth in vehicle kilometres travelled,
- To improve connectivity to and within Aberdeen, especially by public transport, walking and cycling,
- To improve connectivity to and within towns in Aberdeenshire, especially by public transport, walking and cycling, and
- To enhance public transport opportunities and reduce barriers to use across the north east, especially rural areas.

The model was then used to assess the impacts of these initial packages. To assist in the further development from this base set of packages and to involve the key stakeholders in moving forwards from this position we employed a new “real-time” approach in a workshop setting that gave participants greater insights into the consequences of policy options over the period of the RTS (through to 2021) against their objectives.

We conducted this workshop with members of the NESTRANS board. Participants were able view the original packages and their impacts and then specify and test various transport packages to see how they performed against economic, environmental and social objectives. By making changes to the transport packages, such as providing additional capacity for buses, new rail services and varying levels of parking charges, the participants could see the impact each had on key economic, social and environmental indicators and, in particular, identify with the tensions between competing objectives. The outputs and implications were discussed amongst the attendees and further changes made as the group moved towards an agreed strategy. Over the course of the workshop further packages were developed including combinations of measures that were part of different initial packages. In this way movement was made towards agreement on a preferred package which met all the objectives of the RTS.

3. THE MODEL

The Urban Dynamic Model (UDM) is designed to simulate how areas might change over time, typically ten years but sometimes twenty or more. It is a simulation, meaning that it uses information about how people and businesses in the real world are believed to behave to generate that behaviour in a computer model over long periods of simulated time.

Methodologically it lies in the field of systems modelling. This had its origins in the 1960s (Forrester, 1969) but modern computer technology and data sources have greatly enhanced the potential of this approach (Wilson,2000; Allan, 2000; and Ness et al, 2000). Its key characteristic is that it allows explicit representation of sequences of cause and effect and of feedback. Feedback occurs when decisions taken at one point in time set off a sequence of events that change the conditions under which those decisions were made. Urban areas are replete with feedback, sometimes taking years to reach their full impact. Decisions about land use for employment will affect business activities, jobs and commuting patterns. These impacts may in turn affect demand for housing, decisions about residential land use and transport infrastructure. Decisions about car use will affect congestion and travel conditions, and so on.

To put the model to use, the area being studied is divided into zones, and each zone populated with information describing its position in a base year, including:

- The total zone land area, the area allocated for housing and employment use, and the area allocated but not yet built on;
- The numbers of housing units, split by type;
- The number of business and employment premises, split by type;
- The number of households, split by type;
- The number of businesses and associated jobs, split by type.

The zones are linked by the transport networks. These are represented as the times and costs associated with travelling between each pair of zones and within zones. The model can differentiate between highways, public transport, walk and cycle.

Over time the contents of each zone will change as people and businesses make decisions about where to locate, where to work, and so on. The ways in which these decisions are made are crucial, both in the real world and the model, for they are the drivers of change.

3.2 Businesses

A central idea used in the model is that each location can become more or less attractive as a place to do business (for businesses and employers[2]) as conditions change over time, and that within the scope of this model, attractiveness is related to:

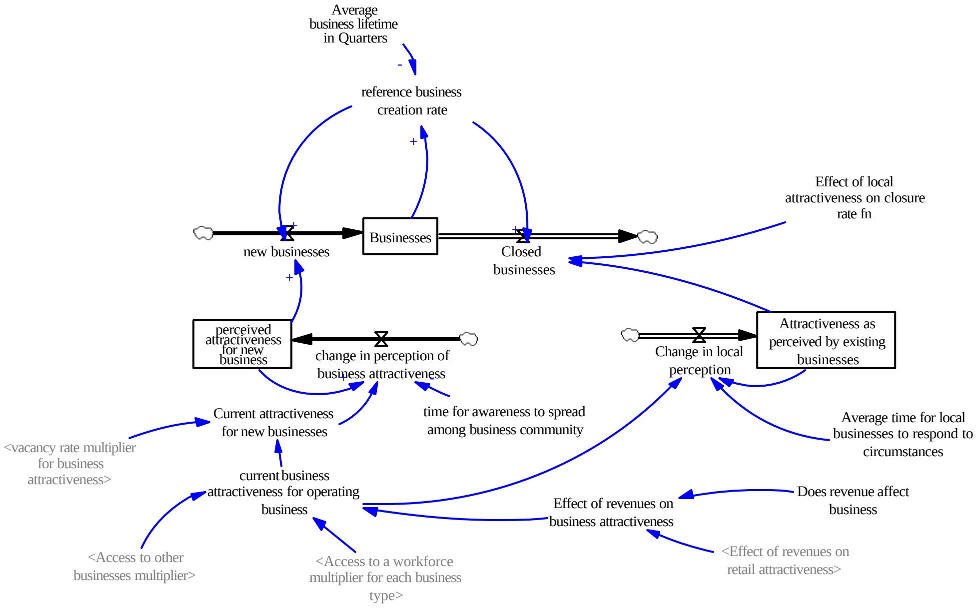
- The ability to recruit a workforce
- The availability of suitable premises
- Access to customers and suppliers.

When a location becomes more attractive we also assume this will have two primary effects:

- More businesses will be attracted to the area, as they seek to exploit the advantages of the location; and
- Existing businesses will tend to last longer because of the favourable conditions.

In other words, the overall business start-up rate increases, while the closure rate declines. Conversely, if the attractiveness falls, the start-up rate will fall as fewer businesses seek to locate there, while the closure rate will increase as more businesses close or move to more attractive locations. This is expressed pictorially in Figure 1. Here the rectangle represents the 'stock' of businesses active in a given location, while the inward flow represents a flow of new business start-ups and the outward flow is the flow of departing businesses. The attractiveness alters the rates of business start-up and closure and thus over time the total numbers of businesses will change[3].

Figure 1: Arrival and departure of businesses in a zone



So if a zone becomes more attractive, we assume this will tend to increase business activity, until new local constraints, such as the ability to recruit, or the availability of suitable premises, slow the growth and eventually halt it. We also assume that there will be a lag between conditions changing and businesses responding, because it takes time for awareness to spread and for businesses to organise new activities.
Technically the attractiveness is simply a multiplier used to scale the two rates up or down as conditions change, but it has to reflect the three factors defined above.

The simple argument assumes that each zone contains enough businesses for average start-up and closure rates to have a useful meaning: it would not apply to specific sites or businesses. Also it does not distinguish between the different ways in which business activity can increase: expansion of existing businesses, new start-ups or inward investment. It simply assumes that if attractiveness improves, then more business activity will take place, and vice versa, without worrying about the source of that activity.

For reference the diagram in Figure 1 was drawn with the modelling software, Vensim. Each text label represents either a variable or a data item. If a variable, then there is a formula 'behind' the label, defining how the calculation is made; if a data item, there is simply a reference to where the data value can be read. All the variables in this diagram are subscripted by zone and business type. This means that the model structure shown here is replicated for every zone in the model, and for every business type within each zone.

The blue arrows indicate the sequence in which calculations are made. Thus the variable 'current business attractiveness for operating businesses' is calculated using three inputs: 'access to other businesses multiplier', 'access to a workforce multiplier for each business type', and 'effect of revenues on business attractiveness'. In turn, 'current business attractiveness for operating businesses' is used in two subsequent calculations, 'current attractiveness for new businesses' and 'change in local perception'.

The 'Businesses' variable drawn in the rectangle is a 'stock'; this records quantities whose values are increased or decreased through simulated time by accumulation or depletion. The rates of accumulation or depletion are also indicated on the diagram, represented as 'valves' on 'pipelines'. These are really derivatives with respect to time, and as the simulation runs the model integrates these derivatives to vary the stock levels. In this case the stock records the number of businesses in a zone at each point in simulated time. 'new businesses', to the left, is the 'flow' of new businesses arriving, while 'closed businesses', on the right, is the outward flow of businesses that close or move out. These are rates of change. The simulation advances through small time steps, recalculating all the variables at each step, and generating near-continuous outputs for all of them. In this implementation one 'time unit' is defined to be a quarter of a year, but the simulation works in smaller steps of one quarter of a quarter year (i.e the entire model is recalculated 16 times per simulated year).

The lower part of the diagram uses information calculated elsewhere in the model to calculate an index for how attractive the zone is for business activities. This index is a value that pivots around one, so that it can be used to increase or decrease the start-ups and closures. A compound index is calculated as the product of three separate indices, each representing a different aspect of the overall attractiveness.

"Current business attractiveness for operating businesses" reflects the attractiveness of the location for businesses already operating in a zone; this is taken to include everything except the availability of suitable premises, and is used to alter the rates at which existing businesses close. "Current attractiveness for new businesses" is designed to reflect how attractive the zone is for new or expanding businesses. For them we assume that the availability of premises is also important, so the index for existing businesses is multiplied by the index reflecting the availability of premises, and this is used to alter the rates at which new businesses arrive.

Neither of these indices is used directly to alter start-ups or closures, because they represent the current, instantaneous level of attractiveness, but as already noted, businesses cannot respond immediately to changes in conditions. Both indices are therefore smoothed and lagged, using a simple stock and flow structure, to generate 'perceived' attractiveness indices. In fact these structures generate exponentially smoothed averages of the input values, with average delays of two years for new start-ups, and nine months for closures. The difference is justified on the grounds that existing businesses know very well what local conditions are like, so the time to gather information and act on it is less than it is for others who may be considering the suitability of the location as somewhere to open new operations.

Access to a suitable workforce

Businesses must be able to recruit a workforce, and in failing areas a shortage of suitable staff is often cited as a constraint on business activity[4]. The inability to recruit will constrain growth, while a plentiful labour supply might encourage expansion.

The model contains a simulation of the recruitment process, in which job seekers are recruited into vacant jobs, with the likelihood of a job seeker being available for a given location declining as transport costs increase. Where employers cannot recruit staff they will have unfilled posts, constraining further growth, but if recruitment is easy job vacancies will be low and this may encourage further expansion. Consequently the measure used to define this element of attractiveness is the fraction of jobs that are vacant.

Therefore the rate at which employers in one zone will recruit from the pool of job-seekers in another depends upon:

- The number of vacant posts
- The number of job seekers in the zone

- The transport costs between the zones, calculated as a logsum across all the available modes
- The effect of employers in other zones competing for the workforce, and of job seekers in other zones moving into vacant posts.

The net effect is that employers in each zone will have some vacant posts that they seek to fill, and that the vacancy rate will reflect the employers' access to the workforce and the competition among employers to recruit them. Changes in transport costs may increase the pool of accessible job-seekers, making some locations more attractive because recruitment becomes easier. The job vacancy rate is used as a measure of the ability to recruit. If vacancies are unacceptably high, this will deter business expansion; if they are low this will at least remove recruitment as a constraint, and may encourage expansion.

Access to customers and suppliers

Proximity to other businesses, who may be customers or suppliers, is the third factor contributing to attractiveness, or especially for the retail sector the general public. An index based on this requires two steps in the calculation:

- Calculation of how many businesses are 'accessible', that is, how many are within acceptable range, taking into account transport costs and times;
- A mapping from this to an index reflecting how important this accessibility is to each business type.

The number of accessible businesses can be calculated using a formula of the form:

$$\text{Accessible businesses } (i,\ bustype) = \sum_j \text{Businesses } (j,\ bustype) \cdot f(\text{travel cost}(i,j))$$

What this says is that for a given zone, i, we consider every other zone in turn, take the number of businesses they contain, weight them by a function of the transport costs between the zones, and then take the sum of them all. The weighting function f() gives a value between one and zero, falling as the transport costs increase to represent the deterrence posed by those costs. The effect is to give greater weight to businesses lying close by, less to those lying further off.

In practice businesses will not give equal weight to the presence of every other business type, so in the model this calculation is extended to allow for the fact that businesses prefer to be clustered with some particular business types over others.

Retail customers are a further class of customer, which is handled rather differently. In the model these are residents, and locations with access to large residential populations will be more successful than those without, while this accessibility is, of course, provided by transport. The model estimates the expected distribution of retail expenditure across zones on the basis of: the average monthly retail expenditure per household; the numbers of households in each zone; the number of retail businesses in each zone; and the transport costs linking the zones. An attractiveness multiplier is calculated based on the estimated revenue per square metre retail floor space, referenced against the average across all zones at the start of the simulation. The multiplier function uses the power function form, $y=x^a$, where a is a parameter to be estimated.

Access to suitable premises

Businesses need premises. Each business occupies exactly one business unit (e.g. an office, workshop etc). If there are no vacant units available, there can be no expansion in businesses, but if vacancies are high, then the availability of units will not constrain expansion, and if rents fall enough they may stimulate new activity. In reality this is mediated through rents, but the model works with vacancy rates rather than money, on the grounds that these can be calculated, and that they are the primary driver of actual rents.

In the view of the world represented by the model these premises are all built by developers, and they, like any other business, will respond to local conditions. During a previous project for the DfT on business locations (Steer Davies Gleave, 2006) we interviewed commercial property developers on the subject of how they came to decide on locations to develop. This was fundamentally a matter of commercial potential: they look for locations where rents will be high and where they can expect rents to rise in future. In the model this is translated into an attractiveness measure for developers, based on:

- The availability of land;
- The current vacancy rates in commercial property;
- The historic growth rate in business activity.

The first of these is included because land is a fundamental necessity for developers. The model's supply of land for building can come from two sources, green field land, or brown field land released after older buildings are demolished. The second is included as a measure of the current state of the property market. The third is used as a proxy for how developers forecast future prospects. The historic growth rate is calculated by the model itself while simulated time runs as an annual percentage rate, and this is projected into the future to indicate future prospects as they might be viewed by developers[5].

The model simulates how developers operate using these three measures to vary the rates at which new stock is built and older stock refurbished or demolished. The contribution to the attractiveness of a location as seen by other businesses is then based on the fraction of business premises that are vacant: high vacancies will usually lead to low rents making a location more attractive, at least on that dimension, while low vacancies will increase rents. The question of whether vacancies are high or low is decided by comparison with a reference value of 3%, a level taken to represent a market with a satisfactory turnover rate. The model calculates the relative vacancy rate as “actual fractional vacancy rate / reference fractional vacancy rate” and then generates a multiplier using a power function of the form “multiplier = relative vacancy ^ *a*”, where *a* is a parameter to be estimated. If $a<1$ the function will rise as the vacancy rate rises, which is what is required. Also, when the relative vacancy rate is 1 the multiplier will be 1 (i.e it will have no effect) and when vacancies are zero, the multiplier will also be zero, preventing any further expansion in businesses.

3.2 The Workforce

The workforce is drawn from the resident population, and that too will change over time. Much as with businesses, locations will have different qualities and attributes that make them more or less attractive as places to live. The model uses the same structural idea as for businesses, that each location has an attractiveness as a place to live, and that as the attractiveness rises more households will tend to migrate in, and when it falls, more will tend to leave. There are many factors affecting attractiveness as a place to live, and a simple view has been taken here, that households need two fundamental things:

- Suitable housing; and
- Suitable employment.

Following the business model, the population migration model is set up so that inward and outward migration rates both alter as conditions change. House builders provide new housing stock, refurbish the old, and demolish stock that is life expired, using a model that is similar to that for developers of commercial premises.

The word ‘suitable’ has been used several times in this discussion. Different people have different preferences and requirements as to the type of house they prefer, or the type of work they can do; businesses require different types of premises, different workforce skills, and have different preferences for the types of business they wish to have close access to. The model is set up to differentiate between types of people, housing, businesses etc, and will attempt to match them up in accordance with those preferences. A worker, for example, is not an undifferentiated element, capable of doing any job that is available, but will only be able to do some of the jobs that are offered at any time.

4. THE DYNAMIC MODEL FOR NORTH EAST SCOTLAND

4.1 Model Structure

The model has been built using the System Dynamics modelling software, Vensim. Vensim provides a high quality generalised modelling system capable of handling the large quantities of data required by the model, and the heavily arrayed capability needed to replicate the same fundamental structures across geographic zones and across business sectors.

The model is a simulation of how the whole area is likely to evolve over the RTS period to 2021. It shows both how transport is affected by these changes and how it can influence them.

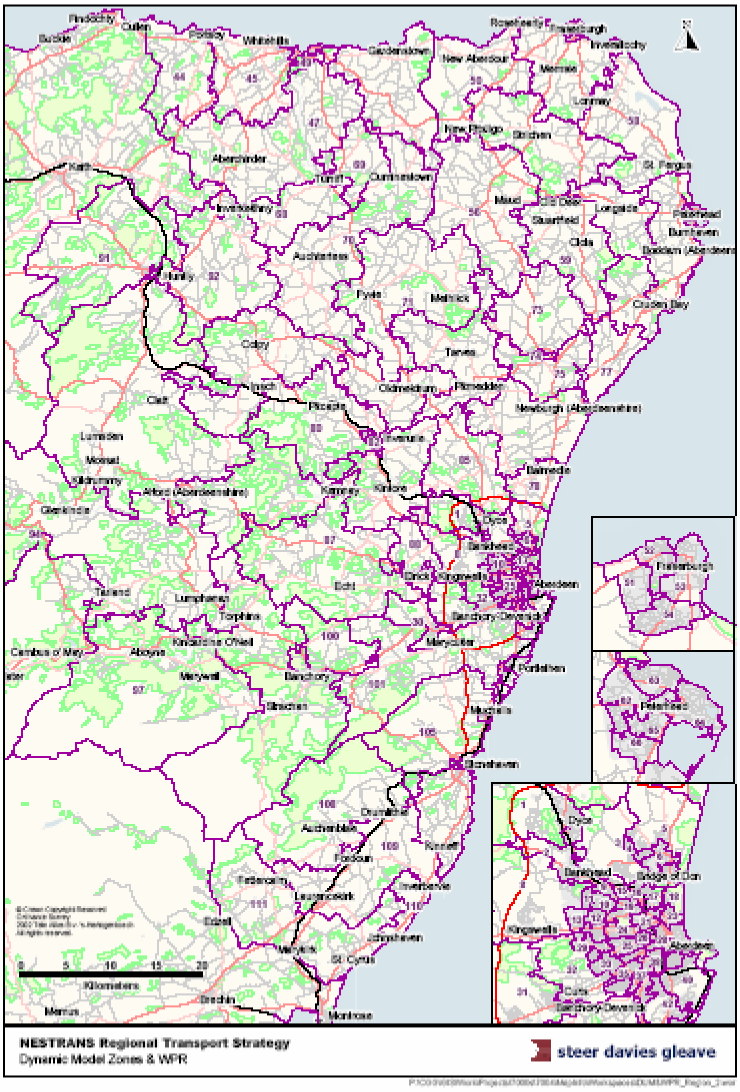
The study area covers most of the North East of Scotland incorporating the districts of Aberdeen City and Aberdeenshire as internal model zones, and adjacent districts of Highland, Moray, Perth & Kinross and Angus as “buffer” zones.

In summary there are:

- 111 internal zones covering the districts in Aberdeen City (43 zones) and Aberdeenshire (68 zones), consisting of individual “wards”. This is the core area of interest.
- 4 buffer zones, designed to “mop up” cross boundary trips to the adjacent districts, including Highland, Moray, Perth & Kinross and Angus.

Figure 2 shows the model zones. In each zone, the model keeps track of: the population, the businesses, the infrastructure, and the land. All of these elements combine to form the current conditions in the modelled region. Each specific zone has transport costs which associates it with the rest of the modelled area; these transport costs have been extracted from the Aberdeen Sub-Area Model (ASAM).

Figure 2: Map of Model Zones



Transport provides the means by which employers gain access to employees, customers and suppliers. The model can represent zone-to-zone travel costs using either a link-based network, or tables of generalised costs. This application of the model uses generalised costs for all the modes represented – private transport (car and motorcycle), public transport (rail and bus) and slow modes (walk and cycle). Three aspects of travel are explicitly modelled: the decision about whether to travel or not; how far/where to travel to work within the study area and the choice of mode. The costs for car and public transport (PT) are derived from the ASAM model whilst the slow mode costs are inferred through car costs and Travel to Work Census data. Mode choice is modelled as this is necessary so that the recruitment process can be handled properly. The model uses conventional logit mode choice models. Household car ownership is included in the model so that car availability can be taken into account in those calculations.

The main dynamics in the model are created via the idea of the attractiveness of each zone for different types of activity. The model monitors each zone through time, and considers how attractive it is from four points of view:

- From the point of view of developers, who build offices and other business premises;
- From the point of view of house builders, who provide the housing.
- From the point of view of businesses and employers;
  - The availability of suitable premises, which are built by developers, and is a function of:
    - i The availability of land;
    - ii The current balance of supply and demand;
    - iii Expectations of future growth .
  - The ability to recruit staff - Each business needs to recruit staff, and if jobs cannot be filled this will limit the expansion of activity. The model simulates how people move in and out of employment over time, and knows the fraction of unfilled jobs at any time. High job vacancy rates will lower attractiveness, while low rates will raise it
  - Access to customers and suppliers.
- From the point of view of households;
  - The availability of suitable housing; with houses built by developers, and similar to the business developers as a function of:
    - i The availability of land;
    - ii The current balance of supply and demand (i.e. vacancies);
    - iii Expectations of growth.
  - The availability of suitable employment - Locations with high levels of unemployment are deemed to be less attractive than those with low levels, so where jobs are easily found, net inward migration will tend to increase, and where they are not, net outward migration will tend to increase.

It is the detailed interaction between these 'actors' linked together through the accessibility provided by the transport system that produces the patterns of development and other impacts observed in the model.

The table below provides a summary of some of the main data requirements to populate the model.

Table 1: Summary of Data Requirements

Businesses and jobs	For each zone, the number of businesses and the associated jobs, split by six sectors (primary; industry & manufacturing; finance and business; retail and catering; education; other services) based on SIC codes to reflect the different ways transport may be used by different businesses. This was compiled from various sources including the Annual Business Inquiry (ABI), Inter-Departmental Business Register (IDBR) and the Small Business Survey (SBS)
Business premises	The stock of business premises, classified by type (commercial offices; shops hotels and restaurants; warehouses and workshops; and 'other'), either occupied by existing businesses or vacant.
Land for business activity	Land shortages could constrain business expansion, while plentiful supply will tend to reduce prices and stimulate growth. An estimate of the available land is therefore needed.
Households and Workforce	The availability of a workforce by skill type is formed from households of different types and have been estimated from the Census and Labour Force Survey. The model must have access to workforce numbers, preferably segmented by skill groupings to match the job categories.
Transport costs	Zone to zone generalised costs or times for highways, public transport modes, and walk or cycle.

4.2 Model Outputs

The model provides extensive outputs for major "quantities." As noted elsewhere the model is zonal with transport costs and therefore flows on an origin-destination zone basis. Many of the outputs are produced by zone and can be reported at each time-step, for example a year, for which the model is run.

The role of the NESTRANS Dynamic Model is to demonstrate how RTS options, can contribute to the economic and social success of the region with the following forming some of the key indicators:

- Economic - How the labour market and business development in Aberdeen City and Aberdeenshire changes in response to changes in accessibility due to the transport system development and land use strategies during the forecast period. The development of the transport system can help to unlock the potential of some of these sites in terms of providing better access to a workforce; and
- Environmental - How the development of the transport system affects the travel to work patterns, mode shares and aggregate car miles;
- Social Inclusion - It also looks at the social success of the region. This is set against a background where there are particular areas that currently have significant low accessibility to public facilities (e.g. university and hospital) so to improve the social inclusion of those areas over the future years.

The incremental change of the above-mentioned indicators as a result of implementation of the RTS options can be used to interpret how well the RTS can meet its objectives over the period through to 2021.

5. WORKSHOP

As has been mentioned previously, a workshop was carried out with members of the NESTRANS board to facilitate the development of the preferred RTS package of options reflecting an appropriate balance between the objectives.. Attendees found this approach to be extremely valuable.

There were a number of factors that contributed to the success of the workshop as a forum for progressing the RTS option development process which relate to both the characteristics of the model and to the way the outputs were presented. Perhaps over-riding this, preparation for the workshop was crucial and having the results from a number of packages that had been run prior to the workshop available to start the discussion and convey the idea that to achieve all the objectives of the RTS trade-offs between the scale of the impacts of different objectives would have to be made. For example packages that promoted strong economic growth may not necessarily support the environmental objectives of reduced car miles without appropriate measures being in place. This was a key mind-set for attendees to sign-up to in order to make the workshop a success.

The model architecture itself is advantageous as it is relatively transparent. Therefore it is possible to explain to people, using the model view, how it works and what the factors are within it. This helps to allay any fears about the model being perceived as a “black box”.

In the workshop environment the model run time presented significant advantages. A model run for the RTS period took approximately 5 to 7 minutes and so over the course of the workshop approximately 15-20 different model runs were undertaken. The model architecture is also such that it allows variables to be easily and quickly output and imported into a spreadsheet package where the results can be tabulated and presented in graphs to show comparisons for indicators against those for other options.

Another crucial aspect was the ability to determine in advance the focus of the model outputs. A relatively small number of key indicators were identified representing the different objectives of the RTS but sufficient to allow comparisons to be made across options. This reduced the amount of information that needed to be output from the model and presented; and allowed model outputs to be presented on a common basis. Focusing on a few indicators allowed the attendees to concentrate on the objectives and not get distracted by vast quantities of data. The attendees could see the results of the different packages within a short space of time which meant that great progress could be made in the workshop.

The approach taken allowed the attendees to discuss the outputs of the option packages as they evolved. Other options were specified that could either be run in the background during the discussion or over a break in proceedings.

The following graphs show some illustrative outputs that were used in the workshop. It should be noted that these graphs do not show real outputs from the workshop.

The first graph shows the total number of jobs in each area under each model “run” which relates to an option package. The second shows the percentage change in “filled” jobs i.e. those jobs that are not vacant in each area for each model run compared to a reference case and the third shows the percentage change in car miles under each model run compared to a reference case. As further runs were undertaken the results could be added to the graphs and so a continuous assessment could be made of the relative contribution of the options tested to the objectives as measured through these high level indicators. Although obviously the final assessment would include a lot of other indicators.

Figure 3: Total Jobs in 2021

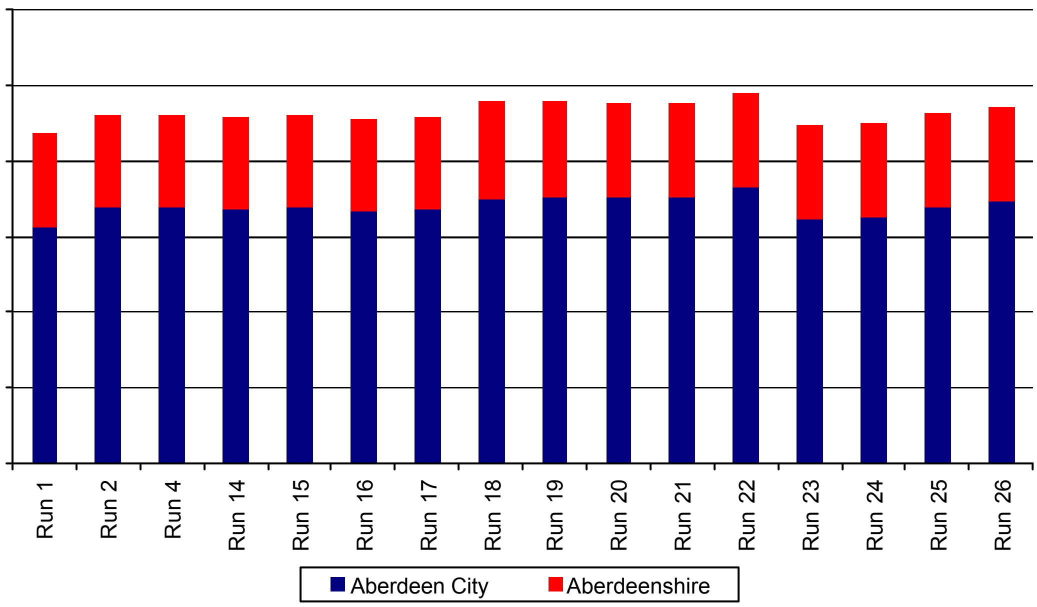


Figure 4: Percentage Change in "Filled" Jobs in 2021 compared to a Reference Case

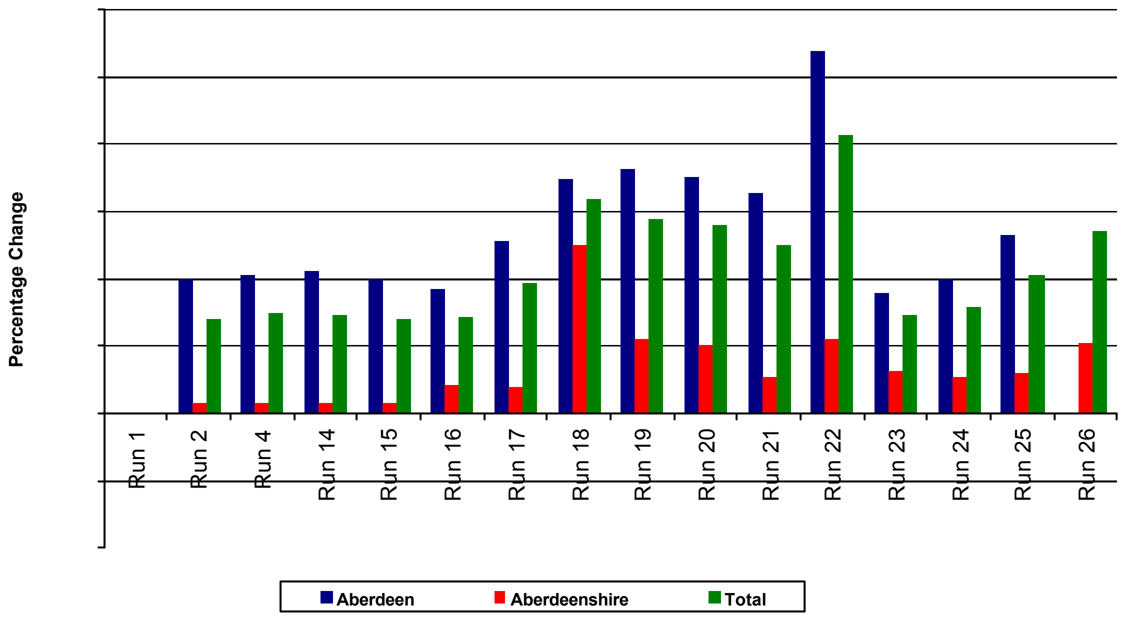
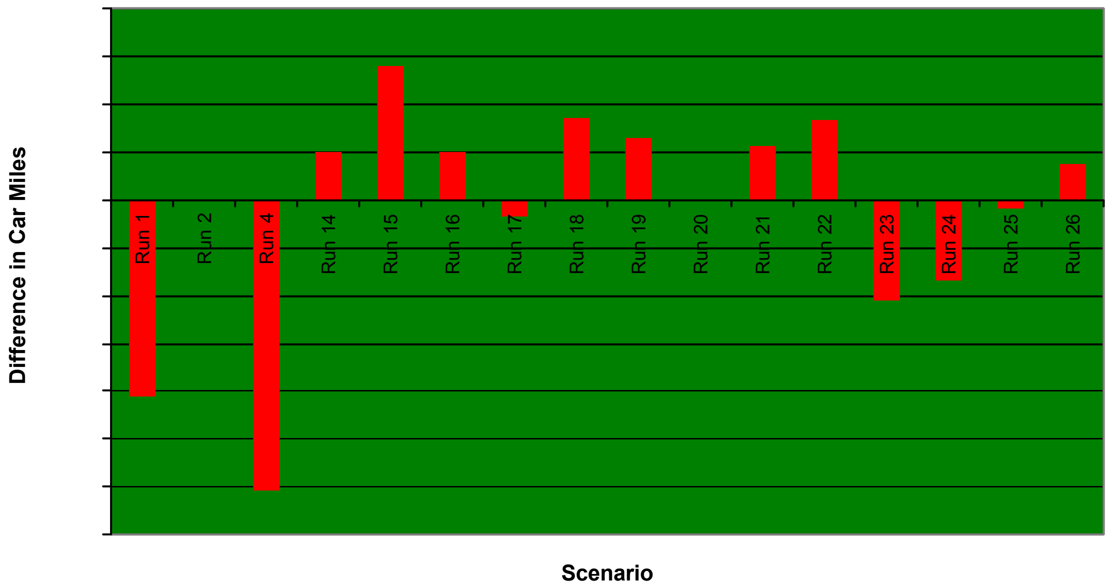


Figure 5: Percentage Difference in Car Miles Compared to Reference Case



Subsequent to this workshop there was a feeling on "buy-in" on the process that was being followed to assess the packages partly because the stakeholders had had some exposure to the model that was being used.

6. CONCLUSIONS

This paper describes how Steer Davies Gleave utilised an application of its Urban Dynamic Model (UDM) to support the development of a Regional Transport Strategy (RTS) for NESTRANS as a tool to assess the impacts of options against the objectives of the RTS. But also as a tool to inform the development of those options and its use within a workshop environment enabled stakeholders to both understand the model and also to engage in the option development process by seeing outputs from the model for different option packages and discuss these and start to make trade-offs and move towards an agreed package.

The key elements for the success of option development within the workshop were to have a model that was suitable and feasible to run in such an environment and to have a small number of measurable but significant indicators from each model to enable attendees to make high level assessments of the trade-offs of achieving different objectives of the RTS to different degrees.

Notes

1. The new Regional Transport Partnership (RTP) is required by the Transport Act to create a Regional Transport Strategy (RTS) for its region by 1st April 2007
2. The term 'businesses' is used in this paper, but should be understood to include all employers, not just those in the commercial sector.
3. In practice the flow of new businesses can arise in three ways – new start-ups, inward investment and expansion of existing businesses – but this distinction is not made here.
4. See for example http://www.onenortheast.co.uk/page/skillshighered.cfm
5. In other words the model simulates how developers make forecasts of future market conditions.

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