TEST – A TOOL FOR EVALUATING STRATEGICALLY INTEGRATED PUBLIC TRANSPORT

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ABSTRACT

The EPSRC-funded TEST project has developed a strategic evaluation tool for integrated public transport. The prototype software helps users to explore the most appropriate public transport technology (or technologies) for urban and short distance inter-urban corridors.

The tool aims to support the strategic assessment of local transport networks by transport planners and operators. For this purpose it combines a number of features:

- The integration of a series of existing and new simulation models covering public transport and highway traffic demand and supply;
- The inclusion of demand effects (congestion, generated demand, modal shift) and environmental effects in total social cost;
- Operating costs based on up-to-date data for each mode, with the option to adjust to local conditions.

A spreadsheet model was developed that calculates total social costs as the sum of total operator costs, total user costs and total external costs. This spreadsheet model was linked with a public transport network model (VIPS) and with highway network models (CONTRAM, SATURN) to form the TEST software tool. Through an iterative process, this permits transport demand to be treated as endogenous to the modelling system. We believe the TEST tool represents an important practical and academic advance on existing software.

In this paper, the innovative aspects of the model will be described and illustrated. In particular, results will be presented showing the application to a case study of a guided bus system on a busy urban/inter-urban corridor in Oxfordshire. For example, the model calculates an overall increase in social costs (if capital infrastructure costs are included), in contrast to an overall social benefit if capital infrastructure costs are excluded. The benefits are mainly the result of improved service levels for inter-urban bus services and overall decongestion on the road network, while the disbenefits include increased transfers for local services and the dominant capital infrastructure costs.
1. INTRODUCTION

1.1 Background

The TEST tool is the main outcome of the EPSRC-funded TEST (Tools for Evaluating Strategically Integrated Public Transport) project undertaken at the University of Oxford. An earlier version of this paper was presented to the Universities Transport Study Group (Brand and Preston, 2004). Our partners in this work were Mott Macdonald, a leading engineering consultancy, the Go-Ahead Group, the leading public transport operator in Oxford, and Oxfordshire County Council. The background to this research arose from academic and practical needs. The academic need was to update and extend the work on accounting, econometric and engineering cost functions for public transport that originated with Meyer, Kain and Wohl (1965). This work has tended to concentrate on conventional bus, light rail and heavy rail technologies. It does not cover new intermediate public transport technologies such as kerb guided bus and electronic guided bus. Similarly, neither hybrid bus systems, including the magnetic based system being developed by Ansaldo, nor hybrid rail systems, such as the Karlsruhe track sharing system (see Axhausen and Brandl, 1999), are covered. Other developments in transport that have not been well covered by this literature include new technologies that have reputedly lowered light rail costs and personal rapid transit systems, such as the Urban Light Transport (ULTra) system that is being proposed for Heathrow.

Secondly, the practical need originated from the UK’s Integrated Transport Policy White Paper “A New Deal for Transport” (DETR, 1998, para.3.37) which stated: “Light rail, and similar, rapid transit systems, can have a role to play in delivering integrated transport in urban areas – particularly if planned as part of an overall strategy. The capital costs of light rail systems are, however, high – particularly in comparison to bus priority measures and more modest guided bus schemes which may offer a more cost-effective alternative.” The general tone of this quotation was supported by some research, both from the UK and overseas (see, for example, Hensher, 1999). However, a subsequent report came out strongly in favour of light rail systems (LRT) because they permit a more radical approach to car restraint than bus based systems (ETP, 2000). The Deputy Prime Minister, in a significant change of policy, hailed light rapid transit as “the transport mode of the future” (Local Transport Today, 13 April 2000, p.4), whilst the Ten Year Plan had an aspiration to deliver up to 25 new routes by 2010 (DETR, 2000). More recently the pendulum has swung away from LRT with a critical National Audit Office report (NAO, 2004), below forecast readership on the Croydon Tramlink and the Midland Metro and the revocation in 2004 of funding for schemes in Leeds and South Hampshire (SDG, 2005). The Future of Transport White Paper (Cm 6234, 2004) concluded (section 4.28): “Light rail can work best for routes with the highest traffic and passenger flows. Bus options are likely to offer the most effective solutions on most corridors”. The Ten Year Plan targets for light rail appear to have been dropped but without any systematic study of the issues. Scientific studies continue to be required in order to
assess the conflicting empirical evidence and allow an objective assessment of the policy implications.

Two of the main objectives of this project were thus:

- To assess the economic, environmental and social impact of different types of public transport technologies, including guided buses and other hybrid systems, both within urban areas and on interurban corridors; and
- To develop a strategic evaluation tool for integrated public transport that can help determine the most appropriate public transport technology (or technologies) for different corridors.

1.2 Methodology

The methodology involved a detailed desktop review and field studies of 10 public transport systems, involving more than 50 organisations and key experts (see Brand and Preston, 2001, Brand and Preston, 2002a/b and Table 1). The evidence collected was used to develop a spreadsheet model that calculates total social costs (TSC) as the sum of total operator costs (TOC), total user costs (TUC) and total external costs (TEC). This spreadsheet model was linked with a public transport network model (VIPS) and highway network models (initially SATURN but converted into CONTRAM) to form the TEST software tool (see also VIPS, 2001, CONTRAM, 2002). The link between VIPS and CONTRAM was provided by Mott MacDonald. Through an iterative process, this modelling system permitted transport demand to be treated as endogenous to the modelling system. This tool has been applied to a case study of a guided bus system on the Kidlington-Oxford-Abingdon corridor. This demonstrated the ability of the TEST model to provide strategic appraisal of different public transport options. The authors believe the TEST model represents an important practical and academic advance on existing software. Elements of this work have been incorporated into the Commission for Integrated Transport’s advice on affordable mass transit (CfIT, 2005)

<table>
<thead>
<tr>
<th>Rail-based alternatives</th>
<th>Bus-based alternatives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Light rail</strong></td>
<td><strong>Guided bus</strong></td>
</tr>
<tr>
<td>1. Manchester Metrolink (Phases 1-3)</td>
<td>6. Leeds (Scott Hall Road, East Leeds)</td>
</tr>
<tr>
<td>2. Croydon Tramlink</td>
<td>7. Ipswich (<em>Superoute 66</em>)</td>
</tr>
<tr>
<td><strong>Heavy and dual mode rail</strong></td>
<td><strong>Conventional bus lane</strong></td>
</tr>
<tr>
<td>4. Karlsruhe dual mode rail (track sharing)</td>
<td>9. Heathrow M4 spur motorway bus lane</td>
</tr>
<tr>
<td><strong>Personal public transport</strong></td>
<td><strong>Other forms of Bus Priority</strong></td>
</tr>
<tr>
<td>5. ULTra system (Cardiff pilot scheme)</td>
<td>10. Edinburgh <em>Greenways</em></td>
</tr>
</tbody>
</table>

The structure of this paper is as follows. Section 2 gives an overview of the tool including the modelling framework, data requirements and the main
outputs. In section 3, we present and discuss the summary results of a case study validation exercise conducted on the Kidlington-Oxford-Abingdon corridor. In section 4, we draw some conclusions and outline possible areas of further work.

2. THE TEST TOOL

The framework of the implemented model is outlined in Figure 1 and in Brand and Preston (2003a). In order to serve different modelling needs, the total social costing spreadsheet model was developed in two versions:
1. a stand-alone model (no network, just single route corridor), comparing different public transport technologies against varying public transport demands at an aggregate level, and
2. an integrated version at the detailed transport network level (- the TEST tool), including estimates of generated demand, (de-)congestion and modal shift.

Figure 1: Overview of the integrated TEST software tool

2.1 The stand-alone version of the model

The stand-alone version of the model is capable of comparing up to 15 conventional and advanced public transport technologies (bus and rail based, plus personal public transport) on the basis of average and marginal social costing, i.e. $TSC/PKM$ and $\partial TSC/\partial PKM$, where PKM = passenger kilometres. The user sets a small number of route characteristics such as route length, average trip length and value of in-vehicle time. Other parameters such as stop frequency, maximum speed, operating costs by technology etc. are optional in the sense that they are set to typical values which the user can change. A macro then computes various cost indicators for a range of passenger demand levels, including average and marginal operating, user, external and social costs. Further details on methodology and model specification can be found in Brand and Preston (2003a). A key feature of the
model is that all of the default input parameters can be changed and their impact on costs tested. This permits detailed sensitivity analyses.

An example output of average and marginal operating costs (including annualised capital costs) per passenger-km for a typical 12km long urban public transport (PT) route is shown in Figures 2 and 3. The corresponding results for average and marginal social costs are shown by Figures 4 and 5. In terms of average costs, a series of U-shaped curves are apparent. The downward sloping portion of these curves reflects fixed costs being spread across more and more traffic units. Such fixed costs are particularly important for systems with dedicated right of way and signalling. The fixed costs for bus systems using mixed rights of way were determined using the fully allocated costs for PSVs determined by Sansom et al (2001) which was also an important source for input data on external costs. The upward sloping portion of the U-shaped portion largely reflects congestion on the right of way and at stops. Such congestion costs are particularly marked for fixed track systems and systems with small vehicles, such as personal rapid transit. The marginal cost curves (or more correctly incremental cost curves as demand is increased in increments of 1,000 passengers per day) are upward sloping, their more jagged appearance representing the costs of additional vehicles (which is particularly a feature for systems with high capacity fixed vehicle sets).

Figure 2 suggests that, in terms of operating costs, bus based systems are the most appropriate choice for this route if demand is below around 40,000 passengers per day. Above this threshold, rail-based systems become more attractive. Work by Transport for London based on Croydon and quoted by SDG (2005, pp27-28) suggest that in terms of operating costs bus services have an advantage at volumes up to 2,500 passengers an hour, which is consistent with the TEST results (assuming a 16 hour operating day). The TEST results suggest there are relatively limited opportunities for so-called intermediate public transport (light rail, guided bus and variants). Figure 4 indicates that in terms of social costs, buses are the best alternative up to passenger flows of around 30,000 passengers per day. Between 30,000 and 60,000 passenger per day LRV track sharing (as in Karlsruhe) appears to minimise social costs (but opportunities for such systems are limited by railway geography) although at the lower end of this demand range a lot of systems (including modern light rail) are close to the minimum costs. Above 60,000 passengers per day heavy rail systems appear to minimise social costs. The opportunities for guided bus systems appear limited but it should be noted we are assuming here that the technology is applied throughout the length of the corridor. In practice, guidance may be only required along a small section of the corridor to achieve most of the benefits.
Figure 2: Example of average operating costs as a function of demand for a 12km urban PT route (in pence per passenger-km, 2000 prices)

Figure 3: Example of marginal operating costs as a function of demand for a 12km urban PT route (in pence per passenger-km, 2000 prices)
Figure 4: Example of average social costs as a function of demand for a 12km urban PT route (in pence per passenger-km, 2000 prices)

Figure 5: Example of marginal social costs as a function of demand for a 12km urban PT route (in pence per passenger-km, 2000 prices)
2.2 The integrated version of the model

The integrated TEST tool compares a default option (‘Do Nothing’) with one or more alternative (‘Do Something’) scenarios in terms of total social costs, transport efficiency, user, non-user and environmental costs, taking into account congestion, demand and modal shift changes. In particular, demand is treated as endogenous or variable to the system. In contrast, the stand-alone version assesses the total social costs for a hypothetical corridor/route and fixed, exogenous demand only.

The development of the integrated tool involved:

- coding of alternative VIPS public transport networks covering a particular corridor and simulating a range of alternative public transport (PT) supply options compared to the default (or ‘Do Nothing’) option for 3 time periods (am peak, inter peak, pm peak),
- development of the total social costing spreadsheet model in MS Excel,
- development of links between these models and a modified but existing road traffic assignment model, and
- development of an appraisal spreadsheet consistent with TUBA and capable of computing net social benefit (see TUBA, 2002).

The resultant tool is capable of interface with the widely used CONTRAM and SATURN assignment programs. Figure 6 provides a screenshot of the public transport corridor assessed in the case study (as discussed below).

Running the integrated tool involves:
1. Running VIPS and CONTRAM assignments for the networks to be compared: the “Do Nothing” and “Do Something” scenarios.
2. Estimating generated demand for public transport for the “Do Something” scenarios due to changes in generalised cost and running VIPS again.
3. Estimating modal shift between PT and car travel for the “Do Something” scenarios due to
changes in generalised cost and demand and iterating until the difference is less than the desired accuracy (e.g. 0.1%). This usually involves 2-3 iterations.

4. **Updating links and viewing aggregate, comparative results in the TEST model spreadsheet.**

Changes in PT demand are calculated on the basis of a simple elasticity model, taking into account changes in generalised costs and fares. Note this is similar but not equal to the internal VIPS module. Default values of fare elasticities and values of in-vehicle time were the same as those used by Preston et al. (2005).

Modal shift is simulated in VIPS with links to CONTRAM via the VIPS Mode Choice module in an iterative process. Both VIPS and CONTRAM have links with the spreadsheet model to calculate TSC, performance parameters, user and non-user benefits, and external (environmental, accidents) costs.

The VIPS public transport model is the main arena for user input, as all network elements and the main PT service parameters are set in the VIPS network module (Figure 1). This includes node, link, segment and route definitions as well as service level parameters such as headways, hours of operation, time period definitions etc. Fares are either route-based or zonal. Note that consistency of the treatment of costs between all the models was ensured, including discount rates and the price base.

As opposed to vehicle-trips (as in CONTRAM, SATURN and other highway network assignment models), VIPS works with passenger trips from origin to destination zone (or node). This usually requires some form of pre-processing raw origin-destination data, as electronic ticket machine (ETM) data are at the stop (node) level. The assignment of stops (nodes) to zones, and the accompanying walk links, is crucial for an effective link with CONTRAM and indeed the overall outcome of the assignments. The all important requirement for VIPS and CONTRAM/SATURN is that zones must be equally defined, i.e. the ID must be equal (e.g. 10001 for City Centre). The integrated tool can only then estimate modal shift and hence (de-) congestion effects.

3. **CASE STUDY VALIDATION OF THE INTEGRATED MODEL**

3.1 **Overview**

The integrated TEST model was applied to the Kidlington-Oxford-Abingdon corridor in Oxfordshire, with the aim of evaluating the effects of the proposed Guided Transit Express (GTE - now rebranded Expressway Oxford) between the Redbridge and Peartree Park & Ride sites. This corridor is almost 20 km in length, but with the core guidance section of the route being 8 km in length. The corridor serves a population of around 190,000. The Oxford Bus Company (part of the Go-Ahead Group) provided most of the bus demand data, while Oxfordshire County Council provided the calibrated road traffic model (SATURN). The latter was converted into CONTRAM by a member of the project team. Electronic Ticketing Machine (Wayfarer) data were
collected, aggregated and averaged for 3 time periods (am peak, inter-peak, pm peak) over a 2 week period typical for the local conditions (i.e. during term time in mid spring 2003). The time periods were matched against the pre-determined SATURN/CONTRAM road traffic model periods. Note the demand data were extrapolated in line with service frequencies and known market shares because there is more than one major bus company operating in the corridor.

Three alternative networks were coded:

- **Option 1, or default**: simulating current public transport supply.
- **Option 2**: simulating alternative supply based around the proposed guideway, with city centre loop to connect to the same zones as in the default option. Three busy services re-routed via GTE, entering the road network South of the Railway Station.
- **Option 3**: simulating alternative supply based around the proposed guideway, with direct routing past the railway station (no city centre loop; additional walk from/to city centre of 7.5min on average).

Figure 7 provides a screenshot of options 1 and 2 for the am peak, indicating ‘Do Nothing’ (existing supply without GTE, left) and ‘Do Something 1’ (simulating alternative supply with 6 inter-urban and P&R bus routes switching to use the GTE, right) scenarios. The red bars indicate bus passenger link loadings. This clearly shows the location of the alternative bus routes and the change in passenger flows from the Abingdon Road to the Southern guideway and the Banbury/Woodstock Roads to the Northern guideway.

**Figure 7: Bus passenger link loadings, am peak, Option 1 (left) vs. Option 2 (right)**
3.2 Presentation and discussion of results

Table 2 below summarises the main impacts of options 2 and 3 compared to the default option. It should be noted that in order to be consistent with TUBA, fare is now treated as a benefit to operators and a cost to users. In the case of option 2, a large proportion of user benefits is captured by the operator through increased revenues. The main impacts of option 2 compared to the default option can be summarised as follows:

- The “winners” are mainly P&R users, general traffic and the bus operator(s):
  - Total operating costs are reduced due to a reduction in PVR and vehicle-hour savings
  - Non-user benefits of £0.1m p.a. due to decongestion effects
- The “losers” are local bus users on Abingdon Rd and Woodstock Rd and, to some extent, the general public (due to a small increase in environmental impacts).
- Mean unweighted journey times reduce by 3.5% but generalised times only reduce by 1.5% as decreases in in-vehicle time are partially offset by increases in walk and wait time.
- Capital infrastructure costs are the dominant cost element when compared to fleet retrofit costs, user and non-user benefits.
- Overall benefits are likely to be underestimated due to the exclusion of Witney and Bicester services which are operated by Stagecoach and for which data were not available.
- There is a small increase in public transport trips (of almost 1%), implying an elasticity with respect to generalised cost of around -1.5. In terms of passenger-km, there is an increase in public transport use of over 6% but this reflects the longer routing of the Expressway system compared to the bus services it replaces.
- Overall, there is only small modal shift from car to public transport, although this is more pronounced for Abingdon-City Centre and Kidlington-City Centre trips.

For the direct routing (Option 3), the main impacts are as follows:

- Here the “winners” are mainly the general traffic and the bus operator(s):
  - Total operating cost are again reduced due to reduced peak vehicle requirement and increased vehicle-hour savings;
  - Non-user benefits are more substantial as congestion in the central area is reduced.
  - P&R users do not benefit as much as in option 1 due to the relatively long walk (7.5min) from the railway station bus stop to the city centre shops, other bus routes etc. Demand was found to be sensitive to assumptions about the mean walk time for this link.
- Other winners are the general public due to moderate decreases in external environmental costs/impacts due to reduced public transport vehicle-km operated in the central area.
• The “losers” are mainly local bus users on Abingdon Rd and Woodstock Rd., and to lesser extent P&R users who need to walk or change to other buses to get to their city centre destination.
• Although unweighted journey time reduces slightly, mean generalised time increases because reductions in in-vehicle time are more than offset by increase in wait and, particularly, walking time.
• PT demand decreases slightly (<1%) in all time periods.
• Capital infrastructure costs remain the dominant cost element when compared to fleet retrofit costs, user and non-user benefits. The costs may be over-estimated in this analysis as the direct route will not require engineering works to permit vehicles to transfer from the guidance system to on street-running in the central area.

Table 2: Summary table of the main impacts of options 2 and 3 compared to the default case (£ - 2000 prices)

<table>
<thead>
<tr>
<th></th>
<th>Option 2</th>
<th></th>
<th>Option 3</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PT performance</strong></td>
<td>% change</td>
<td>Change</td>
<td>% change</td>
<td>Change</td>
</tr>
<tr>
<td>Number of trips</td>
<td>0.81%</td>
<td>66,750</td>
<td>-0.26%</td>
<td>-21,442</td>
</tr>
<tr>
<td>Number of boardings</td>
<td>1.83%</td>
<td>150,900</td>
<td>0.69%</td>
<td>57,000</td>
</tr>
<tr>
<td>Vehicle-km</td>
<td>2.26%</td>
<td>114,105</td>
<td>-0.08%</td>
<td>-4,249</td>
</tr>
<tr>
<td>Passenger-km</td>
<td>6.47%</td>
<td>1,896,131</td>
<td>4.09%</td>
<td>1,200,456</td>
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<tr>
<td>Vehicle-hours</td>
<td>-5.60%</td>
<td>-14,400</td>
<td>-9.40%</td>
<td>-24,200</td>
</tr>
<tr>
<td>Mean journey time (unweighted)</td>
<td>-3.46%</td>
<td>-0.79</td>
<td>-1.01%</td>
<td>-0.23</td>
</tr>
<tr>
<td><strong>PT operating costs and revenue</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total operating costs</td>
<td>-3.92%</td>
<td>CC</td>
<td>-7.41%</td>
<td>CC</td>
</tr>
<tr>
<td>Total operating costs per vehicle-km</td>
<td>-6.04%</td>
<td>-0.05</td>
<td>-7.33%</td>
<td>-0.07</td>
</tr>
<tr>
<td>Total ticket revenue</td>
<td>1.46%</td>
<td>CC</td>
<td>-0.64%</td>
<td>CC</td>
</tr>
<tr>
<td>Mean fare per trip</td>
<td>0.51%</td>
<td>0.015</td>
<td>-0.40%</td>
<td>-0.006</td>
</tr>
<tr>
<td>Net operating revenue</td>
<td>56.90%</td>
<td>CC</td>
<td>69.23%</td>
<td>CC</td>
</tr>
<tr>
<td>Capital vehicle costs (retrofit of existing fleet)</td>
<td>N/A</td>
<td>15,631</td>
<td>N/A</td>
<td>13,227</td>
</tr>
<tr>
<td>Capital vehicle costs (savings due to lower PVR)</td>
<td>-4.84%</td>
<td>-53,507</td>
<td>-9.90%</td>
<td>-109,420</td>
</tr>
<tr>
<td>Capital infrastructure costs (new track)</td>
<td>N/A</td>
<td>2,422,714</td>
<td>N/A</td>
<td>2,422,714</td>
</tr>
<tr>
<td><strong>Generalised costs and user benefits</strong></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean generalised journey time</td>
<td>-1.52%</td>
<td>-0.02</td>
<td>1.45%</td>
<td>0.02</td>
</tr>
<tr>
<td>Mean generalised costs excl. fares</td>
<td>-0.54%</td>
<td>-0.01</td>
<td>0.56%</td>
<td>0.01</td>
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<tr>
<td>Mean generalised costs incl. Fares</td>
<td>N/A</td>
<td>93,276</td>
<td>N/A</td>
<td>-96,382</td>
</tr>
<tr>
<td>Total user benefits (PT)</td>
<td>N/A</td>
<td>100,963</td>
<td>N/A</td>
<td>175,909</td>
</tr>
<tr>
<td>Total non-user benefits (cars)</td>
<td>N/A</td>
<td>100,963</td>
<td>N/A</td>
<td>175,909</td>
</tr>
<tr>
<td><strong>External costs</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accidents</td>
<td>0.02%</td>
<td>1,099</td>
<td>-0.01%</td>
<td>-840</td>
</tr>
<tr>
<td>Air pollution, noise and climate change</td>
<td>0.01%</td>
<td>10,143</td>
<td>-0.02%</td>
<td>-36,496</td>
</tr>
<tr>
<td><strong>Total external costs</strong></td>
<td>0.01%</td>
<td>11,241</td>
<td>-0.02%</td>
<td>-37,337</td>
</tr>
<tr>
<td><strong>Change in TOTAL SOCIAL COSTS (incl. Capital costs)</strong></td>
<td>0.66%</td>
<td>1,951,012</td>
<td>0.64%</td>
<td>1,904,505</td>
</tr>
<tr>
<td><strong>Change in TOTAL SOCIAL COSTS (excl. capital costs)</strong></td>
<td>-0.15%</td>
<td>-433,826</td>
<td>-0.14%</td>
<td>-422,016</td>
</tr>
</tbody>
</table>

CC = Commercially Confidential

In sum the two alternative options tested here provide:
• A substantial increase in net speed and therefore reduction in in-vehicle time due to the faster Expressway system. This was offset by an increase

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in waiting time and route transfers due to lower service levels on previous parallel routes, with associated transfer time penalties.

- In option 2, public transport generalised costs reduced slightly and demand increased slightly. As a result, user benefits were fairly minor. Similarly, non-user benefits were modest, with the main impact being reduced congestion on the Abingdon Road (see Figure 8). In option 3, public transport generalised costs increased slightly and demand reduced slightly. As a result, user benefits were negative but there were benefits to non-users as a result of less public transport vehicles operating in the central area.

- A moderate reduction in operating costs and, for option 2, a slight increase in ticket revenue. These benefits are, however, much lower than the capital costs incurred in supplying the guideway infrastructure;

- An overall substantial increase in total social costs (if capital infrastructure costs are included), in contrast to an overall moderate benefit if capital infrastructure costs are excluded, with there being little difference between options 2 and 3.

Figure 8: Traffic delays per vehicle on the road network for the am peak – default option 1 (left) vs. option 2 (right)

Due to data and time constraints, only part of the PT supply and demand was coded. In particular, the expressway could be used by longer distance services to Bicester, Wantage and Witney, whilst some Kidlington services could be diverted and, as a result, system benefits are likely to be underestimated. Similarly the disbenefits of re-congestion might be reduced if road user charging was implemented or if key junctions were re-modelled. Overall the results seem consistent with the stand alone model in that for a public transport corridor with medium level demand (the corridor has around
27,500 public transport trips per day) provision of services by conventional bus appears to minimise total social costs.

It should be noted that the physical alignment of the route segments can have a substantial impact on the results. For example, various sub-options were tested simulating different entry points of the Expressway system onto the general road network. The least favourable sub option involved an entry point on the already extremely busy and congested square South of the Railway Station, with negative impacts due to increased congestion and decreased journey time reliability as simulated in CONTRAM. The local authority and bus operator were consulted on the most likely routing, which involves entry points a few hundred metres south of the Railway Station (simulated in Option 2).

The overall results were broadly consistent with the appraisal of the scheme undertaken by SDG (2004) which failed to make an economic case for the core scheme but did make a case for a single track scheme run on a tidal flow basis. However, there were a number of concerns. The first is the treatment of optimism bias which meant that capital costs were inflated by SDG by 26% of base costs. The second is the assumed value of time for bus travel. SDG assumed that less than 1% of bus users are travelling in the course of business. However, there is some evidence to suggest that up to 20% of bus-based park and ride in Oxford could be made in the course of business. This would mean higher values of time leading to modest increases in use and more substantive increases in user benefits. The third is that in the scheme appraised by SDG the expressway was used by up to 27 buses an hour, whilst in the TEST appraisal the maximum service level modelled was 198 buses an hour. We estimate that adjustments for the second and third concerns might double the gross economic benefits in Table 2 but this would only increase the cost benefit ratio from around 0.2 to 0.4 (the cost benefit ratio of the core scheme appraised by SDG was 0.65).

4. CONCLUSIONS

We have developed two complementary modelling approaches in this paper. The stand-alone spreadsheet model is for use in strategic analysis of public transport technology choices. In general, it suggests that in a UK context there may be only limited scope for intermediate public transport systems, with the LRV-track sharing system pioneered in Karlsruhe appearing to be the most promising system (when rail tracks are available). However, in specific locations it may be that guided bus and light rail technologies will be appropriate. For guided bus, this is most likely to involve small sections of guidance that can by-pass congestion hot-spots. For light rail, this is most likely to be where existing rail alignments can be utilised.

Our integrated model can be used for more detailed assessments at the network levels. The model is based on CONTRAM and VIPS network models and has been validated for a proposed guided bus system in Oxfordshire. Our results suggest that the guided bus system leads to modest but significant reductions in operating costs and, at least for option 2, increases in revenue.
However, it has little impact on public transport patronage because reductions in in-vehicle time are largely offset by increases in wait and walk time. Public transport passengers travelling from Kidlington and Abingdon to the City Centre and P&R users at Peartree and Redbridge are the main gainers but public transport users that have origins or destinations in Oxford, other than the city centre, loose out as a result of reduced bus frequencies. Non-user benefits are relatively modest due to the limited mode shift that is achieved and the congestion caused by on-street running of the public transport vehicles in the central area. With daily demand of less than 30,000 passengers per day, the corridor does not appear to justify a relatively capital intensive guided bus system.

Further development work on the TEST model will focus on its usability and transferability. With respect to usability a key priority would be to automate the iteration process between the highway network model and the public transport network model. With respect to transferability, there is scope for developing links with other highway and, particularly, public transport network models. The VIPS model has now been subsumed within the wider VISUM suite of models (PTV, 2006). There is also scope for integrating the TEST model with other databases, in particular with the Census 2001 Journey to Work statistics, and with timetable based models such as PRAISE and QBM (Preston et al., 1999, 2005). Some further work is required to make the TEST appraisal output consistent with TUBA and the advice given in www.webtag.org.uk. Variants of the TEST model are currently being applied in South Hampshire to assess public transport options in the Southampton - Portsmouth and the Fareham - Gosport corridors.

References


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