# Appendix C –Model Enhancement Options

## 1 Model Enhancement Options

1.1 Table C1 outlines the initial list of enhancement options that will be addressed within the Enhancement Report for TMfS and are as outlined in our Quality Submission.

**Table 1**

| Enhancement No. | Enhancement |
|---|---|
| E1 | Use of alternative modelling platform |
| E2 | Extension of the geographic coverage of the model |
| E3 | Enhanced use of existing or new data |
| E4 | Enhancements to the current TELMoS Model |
| E5 | Wider economic benefits modelling |
| E6 | Planning and development database |
| E7 | Land-use Model release version |
| E8 | Creation of a model hierarchy |
| E9 | Weekend modelling |
| E10 | Walking and cycling |
| E11 | Concessionary travel |
| E12 | Testing the effects of integrated ticketing |
| E13 | Analysis of bus congestion |
| E14 | Automated use of public transport timetable data |
| E15 | Multiple occupancy vehicle modelling |
| E16 | Enhanced modelling of parking |
| E17 | Enhanced Model Validation |
| E18 | Increasing awareness of TMfS |
| E19 | Accessibility related enhancements |
| E20 | Sub-area models |
| E21 | Automatic links to microsimulation models |
| E22 | Environmental related outputs |

| Enhancement No. | Enhancement |
|---|---|
| E23 | Geo-rectification |
| E24 | User-friendliness |
| E25 | Reducing run times |
| E26 | Maintaining consistency with other modelling platforms |
| E27 | Risk/Uncertainty Assessment |
| E28 | Modelling the impact of soft measures |
| E29 | Incorporating new Government requirements |

1.2 These enhancements are now discussed in greater detail in their respective categories, which are:

- Cnsideration of the modelling platform;
- Extensions of the Geographic Coverage;
- Enhanced use of existing or new data;
- Extensions to the land-use model functionality;
- Other Demand-related enhancements;
- Public Transport-related enhancements;
- Traffic-related enhancements;
- User-related enhancements (including additional model outputs); and
- Other enhancements.

1.3 Each of these categories is discussed in turn below. It should be recognised that these enhancement items will be dealt with in greater detail within the Enhancement Report.

## 2 Consideration of Alternative Modelling Platforms (E1)

2.1 The current transport model uses Visual Basic User Interfaces to control an underlying CUBE-based multi-modal model. There are a number of potential benefits from converting some or all of the CUBE components to other software platforms including Voyager, SATURN and/or VISUM. There is also potential to make use of the DfT's software for demand modelling, DIADEM, though its capabilities are currently very limited compared to those of TMfS.

2.2 These 'potential' benefits of changing software platform include:

- additional functionality of the corresponding modelling software;
- improved/more straightforward interfaces with other models (particularly microsimulation sub-area models);
- improved run-times; and
- improved 'future-proofing'.

2.3 We will consider carefully the costs and risks of any upgrade, (some of which could be significant) and set these against the likely benefits. MVA has the in-house capabilities and experience of the alternatives necessary to robustly undertake this assessment, and have recently carried out a similar preliminary assessment for TfL in respect of the London Transport Studies (LTS) model. It is crucial that this consideration takes place early in the new commission, so that full advantage can be taken of software capabilities in the detailed specification of model enhancements.

## 3 Extension of the Geographic Coverage (E2)

3.1 A key component of your stated requirements (as listed in Section 6.1 of the Project Brief) is a desire to extend the geographic coverage of the TMfS model to better cover the whole of Scotland, with a corresponding need to include additional ferries and internal air travel within the mode-choice and travel demand modelling.

3.2 This extension raises issues such as the time-of-day definition of longer trips, and requires enhancement to the required network and land-use detail in the Highlands and Islands. These changes may lead to alterations in the demand modelling structure and the operating processes as the long distance travel component will not be required in all applications. NB Our recommended approach to handling these **long distance trips** was considered in more detail in our previous TMfS Model Enhancement Report and will be revisited during Work Package LS2.

3.3 There are also beneficial impacts on other components of the TMfS/TELMoS modelling suite. For example, the environmental appraisal module (ENEVAL) could be extended to provide a national estimate of $CO_2$ and other emissions, incorporating all travel modes (not just road traffic).

3.4 This extension would make full use of the available Scottish Household Survey (SHS) Data, the 2001 Travel to Work data and other available sources of relevant demographic and travel data (eg to inform the setting of parameters associated with mode choice).

3.5 The extension of the geographic coverage may need to be combined with some rationalisation of the zoning system used to determine changes in travel demand (while retaining the full network detail), to ensure run-times for the demand forecasting component of the model remain reasonable. In particular, we believe it will be useful to consider converting the model to a hierarchy with a strategic National Demand model at the top feeding more-detailed Regional models capable of detailed modelling of local route and mode choice. This option is discussed in more detail in the demand model enhancements below.

## 4 Enhanced Use of Existing or New Data (E3)

4.1 We will undertake a wide-ranging consideration of data sources and additional data collection, including:

- additional Stated Preference surveys to give better estimates of key model parameters – in particular to allow us to separately model the behaviour of those eligible for Concessionary Travel and to better calibrate the Scottish trade-off between time and money (particularly parking charges and road tolls);
- update of the relevant planning data (not later than April 2008);
- further use of Scottish Household data and 2001 Census Travel to Work data to refine our modelling of current mode-choice behaviour across Scotland (building on our previous SHS Mode Choice research) – in particular we will examine differences in mode choice behaviour between long and short journeys and could incorporate the effect of non-motorised modes in the analysis, particularly for short trips;
- increased use of SRTDb data (notably classified traffic flows and changes in these over time) for calibration and validation purposes - we highly recommend closer links and increased data-sharing between the SRTDB and TMfS (eg to combine historic time series from the SRTDb with future projections from TMfS). These recommendations were set out in our End of Term report and, for brevity, are not repeated here;
- investigation into the use of Map Mechanics and/or other data sources providing average speed\volumes data (for validation). This will also assist in improving the speed\flow characteristics of the model;
- investigation into the feasibility of using Trafficmaster all-vehicle average journey times on key sections of the Trunk Road Network (for calibration/validation of the speed-flow relationships used for these sections of road network in the model);
- use of the growing Concessionary Fares Travel Database – see potential public transport enhancements below; and
- use of the forthcoming National Rail Survey data (to provide more-detailed rail patronage data and facilitate enhanced rail mode-choice prediction by journey purpose).

4.2 As required by Section 2.1.4 of the Project Brief, we will work closely with the Data Collection Consultants, as we have done in the previous commission, to ensure efficient specification and collection of all new data.

## 5 Extensions to the Land-use Model Functionality

### Enhancements to the Current TELMoS Model (E4)

5.1 We have previously-identified a set of recommendations for the Land-use model, including:

- adding and improving the impact of distance on housing relocation (to make it less likely that households relocate significant distances), building on the corresponding enhancements in other DSC models;
- completion of the full incorporation of the 2001 Census Travel to Work data;
- a review of the household and employment location parameters within the model (drawing on the latest demographic and Scottish Household Survey data);
- geographic disaggregation of the land-use development models;
- enhancements to the land-use development models to enable them to forecast future development density (as well as area);
- enhancement of the land-use development model's treatment of redevelopment and change of purpose development, backed up by a corresponding data collection/consultation exercise with Local Authorities regarding the prospects for such redevelopment; and
- enhanced modelling of Goods Vehicle growth – there is scope to improve the prediction of future goods vehicles demand – NB this will require significant additional data on the links between land-use and commodity movements.

5.2 Additional details of these proposed enhancements were provided in our End of Term report and/or in our previous Model Enhancement report. For brevity, these details are not repeated here.

5.3 **Wider Economic Benefits Modelling (E5)**

5.4 In addition to these previously identified TELMoS enhancements we feel there is also a strong case to add functionality under the general heading of 'Wider Economic Benefits'.

5.5 The guidance on Wider Economic Benefits published by the Department for Transport in July 2005 provides methods which can address the question of how well-chosen transport interventions could help to expand the Scottish economy in total. This is a potentially valuable extension to the existing TELMoS system, which currently concentrates on modeling the possible redistribution of economic activity given a fixed size for the overall Scottish economy.

5.6 The DfT method is well-suited to being implemented in conjunction with the MVA/DSC approach to LUTI modeling, and is already being used in conjunction with their models of Greater Manchester and of South and West Yorkshire. One option for TELMoS is to implement this methodology as an additional and more formal element of appraisal, to assess the benefits (or disbenefits) of schemes after the model has been run (this is what is being done in Manchester and Yorkshire). A further more sophisticated possibility is to recognize that the DfT methodology is not just an appraisal method but actually proposes a number of additional economic models which could in fact be incorporated into the TELMoS system. In this approach, the additional economic growth that may be identified using the DfT method will not only be counted as a benefit but will be fed back into the model system, so that its consequences (potentially including increased incomes leading to higher car ownership, and increased demands for goods movement) could be taken into account.

### 5.7 Planning and Development Database (E6)

5.8 The current TELMoS model provides an extremely valuable resource as a consistent database of current and future land use across Scotland. Later in this document we set out proposals to build on this aspect by providing improved access to these land-use planning data and associated measures of accessibility.

### 5.9 Land Use Model Release Version (E7)

5.10 Consideration could be given to the preparation of a Release version of the Land Use model in a similar way to that of the current TMfS model. (ie the model will be provided by license from Transport Scotland and will require the relevant software licenses).

5.11 We believe this is a key element for discussion initially with you and thereafter with the user group. We would quantify the benefits and disbenefits of such an undertaking, which would involve the following steps:

- the preparation of a User Version of the Land Use and Trip End model;
- the audit of the Land Use and Trip End models; and
- training of users in the use of the Land Use and Trip End models.

## 6 Other Demand-Related Enhancements

### 6.1 Creation of a Model Hierarchy (E8)

6.2 As discussed earlier, in considering an increase in the geographical coverage of the model, we believe there is merit in also considering two levels of detail within the TMfS modelling suite, namely a national level strategic model (concentrating on the demographic, car ownership, freight and strategic long-distance issues (including air and ferry) and a number of regional models capable of handling the more-detailed local route and mode choice (similar in coverage to the current SITM or CEC LUTI models). This approach will overcome many of the difficulties associated with the proposed extension to include the Highlands and Islands. The suite of models will remain fully-integrated but would allow us to target computing resources within the model more-effectively. The lower tier Regional Models would also be extremely useful for the new Regional Transport Partnerships.

6.3 **Week-end Modelling (E9) (particularly the 'Retail Peaks' on Saturday/Sunday)**

6.4 We are currently not convinced that the benefits of full modelling of Saturday and Sunday conditions would warrant the expense of the large data collection necessary to do so. However, we do believe that outputs from TMfS/TELMoS could be used to predict growth factors in the trips generated by key retail locations. This additional facility would use TELMoS land-use and demographic forecasts and TMfS-based measures of accessibility and, if available from other enhancements, automatic incorporation of weekend public transport timetable (eg ATCO.CIF) data.

6.5 **Walking and cycling (E10)**

6.6 The current version of TMfS does not explicitly model non-motorised modes and for most of the strategic trips within the model these modes are usually not particularly relevant. However, given the importance of these, particularly regarding issues such as the health benefits for walking and cycling and the growing need to consider the sustainability of Scottish travel, we feel there is merit in considering the likely impacts of policy measures on the levels of walking and cycling. This would use outputs from TMfS and analysis of Census Travel to Work and SHS data to predict the general impact of changes in travel costs (eg the introduction of concessionary travel, road tolling or parking restraint) on the levels of walking and cycling. For the avoidance of doubt this approach would NOT include full modelling of walk and cycle modes for all journeys in the model.

## 7 Public Transport-related Enhancements

7.1 Recent changes have increased the public transport-related responsibilities within Transport Scotland and elsewhere in the Scottish Executive. We will take full account of these changing responsibilities when drawing up our list of model enhancements.

7.2 It can be noted here that we have already significantly improved the representation of current rail travel demand in the model using extensive LENNON ticket-based station boarding data.

7.3 **Concessionary Travel (E11)**

7.4 One area where there has been a significant development in Scottish Executive policy (and available data) is in the area of concessionary travel. Our Edinburgh-based advisors to the Scottish Executive are ideally placed to advise on the likely needs and opportunities in this area.

7.5 We strongly believe that the TMfS model should be extended to include a specific **concessionary travel demand matrix**, either as a single new user class or as a subset of an existing user class. This extension would allow the model to predict the impact of future expansions of the concessionary travel scheme (eg to rail), facilitate the modelling of crowding on local bus services and provide more accurate modelling of the economic and revenue impacts of additional bus services and extensions to the National Concessionary Scheme.

7.6 This enhancement would require significant extension to the current model functionality, including calibration of this group's:

- value of time;
- car-ownership and car–use; and
- their propensity to make additional bus trips (ie making new trips and/or switching from former walk-trips).

7.7 Much of the data for this enhancement could come from the growing database of National Concessionary travel data.

7.8 **Testing the effects of integrated ticketing (E12)**

7.9 Another key area for the Scottish Executive/Transport Scotland and the Regional Transport Partnerships is the design and implementation of Integrated Ticket schemes for public transport, using the ticket equipment required to implement the National Concessionary Travel scheme.

7.10 We believe that a number of minor amendments to the modelling of public transport fares within TMfS would facilitate the use of TMfS for modelling and appraising these integrated ticket schemes.

7.11 **Analysis of Bus Congestion (E13)**

7.12 We have developed tools to analyse bus timetable (eg ATCO.CIF) data to identify network links where congestion is having the greatest effect on bus journey times. We suggest that this utility could be combined with data from TMfS (on bus loadings and peak/inter-peak link speeds) to produce a robust analysis of bus congestion hot spots. This would help identify locations or routes where increased bus priority will have the greatest impact in maintaining and growing bus patronage.

7.12.1 **Automated Use of Public Transport Timetable Data (E14)**

7.12.2 We feel there is considerable scope for using existing electronic timetable data (eg from ATCO.CIF files) and NAPTAN bus stop location data, both of which are regularly updated to provide real-time public transport information, to identify discrepancies and changes to the public transport services which are modelled within TMfS. This is not straightforward to set up, but once undertaken, would greatly simplify the process of keeping the representation of public transport services up to date periodically and would also facilitate the coding of other time periods (eg if a decision was taken to model weekend conditions).

## 8 Traffic-related Enhancements

### 8.1 Multiple Occupancy Vehicles (E15)

8.2 We have recently incorporated the separate modelling of single/multiple occupancy cars within the current TMfS framework. We therefore believe that this version of the model is well-suited to model the benefits of MOV lanes and other measures designed to have differential impacts on single occupancy vehicles. Even measures such as increasing bridge tolls would have a differential impact on SOV/MOV vehicles since the additional monetary cost falls more heavily on the single occupant driver. Similarly, reducing the costs of public transport would tend to attract more SOV drivers than current occupants of multiple occupancy vehicles.

### 8.3 Enhanced Modelling of Parking (E16)

8.4 We believe that there is a considerable argument for enhancing the modelling of the costs and availability of parking within TMfS (which currently does not take account of parking search time or the locations and availability of alternative car parking).

8.5 However, it would not be straightforward to significantly improve the modelling of parking within the current model structure, which currently only reflects the monetary cost of parking in the driver's destination zone.

8.6 A change to the parking supply must also be considered as a land-use issue, given that land-use planning policies on parking provision have changed dramatically in recent years. Taking account of this would be a further useful step in recognising local authority policies within the model.

8.7 An alternative may be to provide a separate module which considers the availability and cost of parking in all time periods in a limited geographic area (eg Edinburgh City Centre) and adjust the costs and profile of car demand destinations accordingly. This would incorporate some of the TRAM functionality under the TMfS umbrella.

8.8 Potential enhancements of the parking model would be considered fully within Work Package TR1. (NB this extension may benefit from data from additional parking-related questions which have been added recently to the Scottish Household Survey).

### 8.9 Enhanced Model Validation (E17)

8.10 With the possible inclusion of new data sources as noted above (for example Trafficmaster and Map Mechanics data), improved model validation, particularly with respect to vehicle speeds would be possible. In addition, this would also assist in improving the speed\flow relationships within the traffic model.

## 9 User-Related Enhancements (including additional model outputs)

### 9.1 Measures designed to bring TMfS to a Wider Audience (E18)

9.2 We have identified a number of measures designed primarily to allow TMfS to be used by a wider audience.

9.3 These include:

- providing better access to the planning data and land-use forecasts (to allow the model (particularly its TELMoS component) to be used by planners;
- creation of output summaries specifically designed for use by the new **Regional Transport Partnerships (RTPs)**, for example to provide forecasts directly relevant to the targets stated in their Regional Transport Strategies (RTS);
- improved links to Neighbourhood Statistics via datazones so that TMfS outputs (eg accessibility measures) can be added directly to Neighbourhood Statistics;
- a more general set of reporting geographies (eg town\city\agglomeration\region systems, in addition to the current Local Authority-based reports) to maximise the potential use of the model outputs; and
- increased marketing and educating of TMfS across Transport Scotland and the Scottish Executive. This is covered under the Model Support Work packages described later in this document.

### 9.4 Accessibility- Related Enhancements (E19)

9.5 Accessibility is becoming an increasingly important tool in analysing transport schemes. There are many ways to calculate accessibility and several software packages have recently become available to assist in this process eg MVA's Accession software which is currently made available to English Local Authorities to enable them to conduct their Accessibility Planning.

9.6 Underlying any form of accessibility analysis are robust travel times and costs between geographical areas. TMfS contains an ideal source of such information (all across a large geographical area and from a consistent source) which is used within TELMoS and that could be used as part of accessibility analysis undertaken within the modeled area (depending on the level of detail of the specific application).

9.7 By adding readily-available data on the location of key services (eg hospitals) TMfS could be extended to provide initial assessment of the relative accessibility by car and public transport to employment, health care and a range of other services.

9.8 Throughout the CSTCS project, a process of undertaking Accessibility analysis using modeled data was undertaken and results were prepared. It is **recommended** that this procedure be formalised, reported upon and advice prepared for model users on how to undertake Accessibility analysis using TMfS output. This advice could also feed into updating the relevant sections of **STAG (Chapter 10, Accessibility and Social Inclusion).**

9.9 Alternatively, we could develop an improved interface between TMfS and Accession, to transfer the relevant data on future travel and land-use into Accession models for more-detailed accessibility analysis and planning.

9.10 **Sub-area models (E20)**

9.11 In our End of Term report we set out a proposed enhancement to automate the creation of sub-area models which could then be developed and used for more-localised assessments. For brevity we do not repeat the details of the necessary work here, but we do believe there is scope for making the creation of sub-area models more straightforward for model users.

9.12 **Automatic Links to Microsimulation Models (E21)**

9.13 As a special case of the sub-area model enhancement, there is potential to automate the creation of detailed microsimulation sub-area models which could then be used to view specific areas of the TMfS transport network. Ideally these will automatically include the corresponding public transport services. More thought will be required to provide a robust interface in the other direction (ie feeding back delays from a detailed microsimulation model to the corresponding junctions within the main route assignment model).

9.14 The links between TMfS and microsimulation would be significantly affected by the choice of modelling platform – for example, an upgrade to the Voyager software would greatly facilitate the creation of DYNASIM microsimulation models, while a switch to VISUM would make the creation of VISSIM models straightforward. This will be considered in our review of software as noted above.

9.15 **Environmental-Related Outputs (E22)**

9.16 The following list covers various potential enhancements to the environmental appraisal module:

- Scotland-wide traffic emissions, particularly $CO_2$ – straightforward if the geographic coverage of the model is extended to be the whole of Scotland;
- incorporating the greenhouse gas emissions (notably $CO_2$) from other modes (air, rail and ferry services) – will require advice from the relevant emissions experts;
- user interface to allow different assumptions in fuel efficiency, use of bio-fuels etc – straightforward;
- automatic links to noise mapping, eg as required under the European Noise Directive (END) – straightforward; and
- Improved interfaces to Local Air Quality models, eg highlighting areas where future EU air quality standards are likely to be breached – straightforward.

9.17 There is also an issue of whether more should be done to model the strategic environmental consequences of land-use change. This would be logical extension of the role of TELMoS as a planning and development database, although it is likely that your interest will focus on how the environmental impacts vary as a result of transport policy, rather than the overall environmental impact of Scotland's development in general.

9.18 **Geo-rectification (E23)**

9.19 All of the interfaces above would be facilitated by a geo-rectification of the full TMfS road network model to exactly match the alignment of the underlying real road network. This would also allow us to tap into Scottish Executive and Local Authority GIS systems which would give us access to data on facades, 3D-mapping, road type etc. – this would also provide a significant improvement in both functionality and visual presentation.

9.20 **User friendliness (E24)**

9.21 Various enhancements to improve the user-friendliness of the model are in the Work Packages associated with Support and Maintenance of the current and future models.

9.22 **Reducing run times (E25)**

9.23 Throughout the previous commission, we have reduced model run times by over 40% despite additional levels of detail. With improvements in hardware alone, it is anticipated that (for the current version of the model), these run times will be reduced by a further 25% by the end of 2006. Changing the software platform may also provide some run-time benefits. (eg converting from CUBE to Voyager will offer both run time and flexibility improvements). However, many of these improvements will be offset by the increased geographic coverage and the addition of a Concessionary Travel demand matrix. There may still, therefore, be a need to consider the trade-off between model run time and model detail, particularly the level of zone detail used in the travel demand module.

9.24 **Maintaining Consistency with Other Modelling Platforms (E26)**

9.25 As required by one of the commission objectives listed in Section 6.1 of the Study Brief, a significant amount of work will be required to achieve and maintain consistency with other relevant models, including the SITM, the emerging National Rail model, other national travel-demand forecasting tools, GROS demographic forecasts etc. In most instances, TMfS has led the way in sub model definition throughout the modelled area and so it is important that any new models built within Scotland are coincidental with TMfS zone structure. To assist in this, the TMfS zoning system, network and development reports are available on the TMfS web site for download.

9.26 Throughout the development of the existing TMfS, a considerable amount of data sharing was undertaken with SITM, SITLUM, CEC LUTI and Aberdeen Sub Area Model (ASAM). We will continue to ensure that this is the case with any enhancements undertaken to TMfS and, as we have done previously, seek opportunities to share in data collection and to share general data inputs and parameters.

9.27 Historically, the most straightforward way to ensure a degree of consistency or at least a degree of awareness is to have model developers and\or those who commission such models to be present at TMfS presentations and members of the TMfS User Group. In addition, and within this commission we will engage with those who might commission model development to ensure that consideration is given to TMfS.

9.27.1 **Risk/Uncertainty Assessment (E27)**

9.27.2 We will add procedures to help you, us and other users to better understand the reliability of TMfS-based forecasts. Much of this will be in the education of model users, but will also include undertaking sensitivity testing to determine the model's sensitivity to input parameters for a given scheme (eg fare levels or journey times for public transport schemes, speeds on new roads etc).

## 10 Other Enhancements

10.1 **Modelling the Impact of 'Soft Measures' (E28)**

10.2 Reducing travel demand and influencing the mode of transport used (for people and goods) by changing behaviour directly accords with a policy of achieving a more sustainable modal split for journeys. If the full potential of a range of behavioural change measures, commonly known as 'Soft Measures', is realised, then the operational efficiency of the transport system could be significantly enhanced. Potential measures which are currently being considered include:

- car Sharing and Car Clubs;
- workplace and School Travel Plans;
- video Conferencing and Tele-working;
- home Deliveries;
- individualised Marketing;
- promoting Walking and Cycling; and
- travel Awareness.

10.3 However, this is a relatively new area and there are considerable uncertainties about the scale of the effects in practice. In assessing the effect of these measures there are two issues to be addressed. The first is the potential scale of the impact of the measures in terms of changes in travel patterns and the second is how these impacts can be reproduced in a transport model such as TMfS.

10.4 In 2004, MVA carried out work for TfL to establish methods for modifying parameters of the LTS model so that the model outputs could reflect the potential impacts of a range of soft measures. The modifications were made to model constants and to 24 hour to period factors. We suggest that a similar TMfS-based project could be carried out for Scotland. Further details of this recommendation were provided in our End of Term report in the previous commission.

10.5 **Incorporating new Government Requirements (E29)**

10.6 Finally in this list of enhancements we add a 'catch-all' for incorporating any functionality or output enhancement which will help TMfS contribute to evolving Government policy on transport, land-use planning, accessibility, health or social inclusion. These enhancements will be identified by discussions with you and your Policy colleagues in Transport Scotland and elsewhere in the Scottish Executive.