Transport Model for Scotland
TMfS07 National Model Audit – Executive Summary

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Transport Model for Scotland: TMfS07 National Model Audit – Executive Summary

SIAS Limited (SIAS) in conjunction with WSP, acting as the Traffic and Transport Advisor and Auditor (TTAA) to Transport Scotland, was requested to undertake an audit of the model development work for the Transport Model for Scotland (TMfS). This included an audit of the Transport, Economic and Land-Use Model of Scotland (TELMoS) which is documented independently. TMfS forms the key transport modelling tool in the Land Use and Transport Integration in Scotland (LATIS) toolkit (Ref. www.latis.org.uk).

The latest development phase for TMfS involved the creation of a strategic, National Model intended to operate as the highest level of a tiered transport modelling hierarchy. The National Model would then provide a consistent framework for strategic assessment and forecasting across Scotland with the capability of interfacing with regional and/or local area models operating in more detail at lower levels of the hierarchy. The National Model was calibrated and validated to typical 2007 weekday peak conditions and is referred to as TMfS07. Users should seek advice through the LATIS service as to the appropriate tools to use for each intended application.

The TMfS07 development involved the creation of a completely new, geo-rectified network covering all significant strategic network links on the Scottish mainland, the Isle of Skye and ferry links to the main islands. A significant number of new data sources were also exploited in the development of the demand model.

The TMfS07 audit examined the Road and Public Transport (PT) networks, the Road and PT model calibration/validation and the Demand Model development and calibration/validation. The audit relied heavily on information supplied by MVA, which was generally in the form of the Draft Model Development and Calibration/Validation Reports for the Road, PT and Demand models. The TMfS07 networks were also supplied along with other supporting documents and information to enable a review by the TTAA.

Road Model Development

The Road network covers the strategic links including all motorway and A-class roads and some strategically significant B-class roads on the Scottish mainland and the Isle of Skye. In keeping with the change to a more strategic, National Model there is a lower level of network detail in the major urban areas compared with previous versions of TMfS. It should also be noted that junctions are not explicitly modelled in the TMfS07 National Model. The network has been geo-rectified and is now more geographically and geometrically accurate than previous versions of TMfS. The TTAA undertook a detailed review of the Road network coding and concluded

that this was acceptable. Any errors identified were considered minor and unlikely to materially influence the operation of the model, as such, these can be addressed in a future upgrade. Nevertheless, users of the model should bear these errors in mind when examining outputs in a local context.

The zoning system is also more aggregate than in previous versions of TMfS. The zoning detail is more consistent across the model area with less detail in urban areas and the greater degree of aggregation is commensurate with the move towards a more strategic, National Model. The zones themselves are built up from data zones which are aggregations of census output areas and are considered acceptable for TMfS07. The lower level of detail of the strategic network and zoning mean that consideration will be required on a case by case basis as to whether the National Model is the appropriate tool to apply or whether a regional/sub-area model would be more appropriate. Advice on these matters should be sought through the LATIS service.

The Road model matrices were developed using more observed data compared with previous versions. In particular, the matrices made use of the 2001 census journey-to-work data and data from a series of Road Side Interview (RSI) surveys. Fully observed matrices were able to be developed for "to work" commuting trips and also for goods vehicles. The "to home" trips were created via a factoring process on the "from home" trips and trips for other user classes were synthesised. This resulted in matrices with higher proportions of observed data in the AM and PM peaks (approx. 70% AM, 50% PM) and a lower proportion of observed data (approx. 40%) in the Inter peak.

The assignment process is similar to previous versions of TMfS with the exception that junctions are not explicitly modelled and flow-delay relationships have therefore been used throughout to reflect both congested and uncongested travel speeds. Tolling effects are included as standard without the need for a separate Tolling version by using random sampling from a distribution to reflect differing willingness to pay tolls. The Forth and Tay Road Bridge tolls that remained in place in 2007 are reflected in the base model. The assignment process for TMfS07 has been enhanced to include an HGV free-flow speed cap.

Road Model Calibration and Validation

The Road model was calibrated using a matrix estimation process to refine the trip matrices and assignment to match aggregate traffic counts across 43 strategic screenlines. The screenlines are relatively sparsely distributed across the model area reflecting the more strategic, high level nature of TMfS07. Data from the Scottish Roads Traffic Database (SRTDb) and counts conducted during RSI surveys and other independent counts were used in the calibration process.

The changes introduced during the matrix estimation process, in terms of sector to sector movements and trip length distribution, were examined and considered to be acceptable. The modelled to observed screenline flow comparisons were reviewed in conjunction with the guidance in *DMRB*. This showed that while all of the *DMRB* criteria are not met, in general the TMfS07 National Model demonstrates a reasonable, global level of calibration in terms of strategic screenline flows. Similarly, when the screenline comparisons are broken down on a geographical and a link by link basis, the level of calibration is generally acceptable, albeit not quite meeting the *DMRB* standard.

Link count validation was undertaken using independent counts not used in the matrix estimation process. These generally compared average flows along routes and were accompanied by commentary from MVA. While the commentary provided was generally fair,

the TTAA considers this to be a relatively crude indicator of flow validation and that it masks a significant amount of variation along each route.

Heavy goods vehicle flow validation was undertaken using SRTDb data and this showed a reasonable match given the scale and spatial aggregation of the National Model. Flows across the key road bridges were also independently validated and these showed generally good comparisons, particularly on the Kessock, Kincardine, Forth Road and Erskine bridges.

Journey time validation was undertaken along a total of 49 routes throughout the main strategic corridors in the model. This showed a generally good comparison between modelled and observed times in most cases. Some individual routes showed poorer comparisons and some issues were also identified in respect of the quality of the observed data. These should be borne in mind when interpreting the journey time validation and applying the model.

Additional validation was undertaken for trip length, trip distribution, journey purpose, planning and census data. Again, these demonstrated a reasonable match in most cases with some localised variation in the quality of comparisons. More detailed commentary on all the validation processes is provided in the main report.

Public Transport Model Development

The PT and Road networks are integrated in a single TMfS07 network which includes all relevant bus, rail and ferry links as well as zone connectors and walk links. The PT model represents three different user classes and six modes with the most significant mainland-island and inter-island ferry services represented. All significant inter-urban bus services have been coded in accordance with publicly available timetable information. Urban bus services have been coded in a more aggregate fashion by coding these as urban bus corridors with an average frequency. This is considered acceptable in the context of the National Model. The TTAA undertook a detailed review of the PT network and service coding and concluded that this was acceptable. Any errors identified were considered minor and unlikely to materially influence the operation of the model; as such, these can be addressed in a future upgrade.

The PT matrices were also developed using a significant amount of additional information not previously available; including the National Rail Travel Survey (NRTS) data, inter-urban bus survey data and 2001 census journey-to-work information. Non-observed elements of the matrix were infilled via a synthetic process using 2007 planning data and trip rates from TEMPRO. This resulted in matrices that were predominantly based on observed data in the AM and PM peaks (approx. 70%) with a lower proportion of observed data (approx. 40%) in the Inter peak.

Public Transport Model Calibration and Validation

The TMfS07 PT model uses the route enumeration and route evaluation routines in the CUBE Voyager software for the assignment process. The assignment considers crowding effects in the AM and PM peaks for rail services only. A single wait curve for all PT lines and a fares model based on standard return fares have been specified. The PT assignment model parameters were defined during the model calibration process.

The PT model was validated by comparing modelled and observed PT passenger counts and journey times. The flow comparisons were focused on urban cordons around Aberdeen, Dundee, Edinburgh, Glasgow and Inverness. This showed that most of the total cross-cordon PT flows compared well. When examining the cordon totals by PT sub-mode it is clear that there are local variations in the quality of the comparisons across all cordons. Individual link

flow comparisons on the urban cordons show some variability but, while some links show poor comparisons, the majority of comparisons on the Aberdeen, Dundee and Inverness cordons are acceptable. In the case of the Edinburgh and Glasgow cordons, the comparisons are much more variable. While the validation is acceptable in a number of cases it is important to note the variability and poorer comparisons evident across the Edinburgh and Glasgow cordons in key directions in the AM and PM peaks.

Cross-Tay PT flows are good for both rail and bus flows and cross-Forth rail flows are in the good to acceptable range in all time periods. The AM peak southbound and PM peak northbound cross-Forth bus flows are shown to be significantly underestimated. A wider check of rail validation on key 33 links showed that most sites demonstrated a good to acceptable match.

Overall it is considered that the total PT flow validation is generally acceptable, however, it is clear that the PT sub-mode split is not as well represented, including at some key locations. Similarly, the individual PT link flow comparisons are more variable, particularly in Edinburgh and Glasgow in the key directions in the peak periods. MVA has made a series of recommendations for future developments aimed at addressing these matters.

Modelled PT journey times were compared with timetabled values and these generally showed a reasonable match and an intuitively correct trend for the modelled times to be lower than the timetabled values. In consideration of the large variability of bus schedule timetables and constraints of the model, the TTAA is generally satisfied that the modelled bus journey times are appropriately represented. MVA does, however, recommend that model users review the bus journey time validation in their area of interest prior to undertaking model tests.

Comparisons between modelled and observed rail passenger boarding and alighting values were undertaken at all stations and these generally demonstrated a good match. An analysis of the loadings on rail services also demonstrated an intuitively correct trend on the key services.

The TTAA considers that, as a strategic, high level assessment tool, the TMfS07 PT model has achieved a level of validation that is acceptable, however, given the regional variation in the level of validation and the general variation in the quality of the sub-mode split comparisons, the TTAA recommends that particular care should be taken when applying TMfS07 in any PT scheme assessments.

Demand Model Development, Calibration and Validation

The TMfS07 Demand model adopts a similar structure to previous versions of TMfS and the most appropriate, available sources of information have been used in its development. Six journey purposes, four household car availability types and five user classes have been represented. Parking charges have been reflected in the same manner as per previous versions of TMfS and the generalised cost parameters were calculated using the appropriate WebTAG methodology. Park & Ride choice is included as an integral part of the demand modelling process.

The model structure, in particular the order of the mode and destination choice elements, was determined by initial parameter estimation for the alternatives. This demonstrated that a model structure with mode choice preceding destination choice was appropriate and the final demand model parameters were calibrated on this basis. The demand model operates for “from home” trip purposes during the AM and Inter peak periods only, with PM “from home” and “to home” and “non home based” trips being factored from the “from home” trips. This is consistent with the process adopted in TMfS05 and is considered acceptable.

Model realism tests demonstrated that the sensitivities to fuel cost, travel time and PT fares were generally within the WebTAG recommended ranges. The application of the demand model in forecast mode effectively follows the same procedure as per TMfS05.

Overall Summary

The TTAA considers that the TMfS07 development has been undertaken with due skill and care and making best use of the available data sources. In view of this, TMfS07 at a national, strategic level is generally considered to be suitable for its intended purposes of:

- Acting as a key source of transport supply and demand data
- Appraising national policy measures
- Appraising strategic land-use and transport interventions

It should be borne in mind, however, that TMfS07 is a high-level, strategic, National Model developed with a lower level of network and zoning detail commensurate with its strategic purpose. The TMfS07 National Model application should be considered and its outputs interpreted in this context. Should detailed assessments or analysis be required then it is likely that a more detailed regional or sub-area model would need to be used instead of or in conjunction with the National Model. Given the local variation in the quality of calibration and validation across different areas of the National Model, users are advised to take cognisance of the findings and recommendations in this audit and to seek advice through the LATIS service in considering any TMfS07 application.