Subject	**VDM and Forecasting in P/A**	**Project Name**	CLHTM Model Update / A582 BC
Attention	Sarah Palmer, John Collins	**Project No.**	B2327FTB
From	Jacobs		
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1. Introduction

Principles for agreement by DfT:

Seeking approval of the proposed scope and methodology for VDM and forecasting in P/A format as part of the Central Lancashire Highway Traffic Model update

2. Background

Following the submission of the CLHTM 2019 revalidation methodology note DfT have raised concerns about the proposed O/D based VDM approach, which were further discussed during the call with Sarah Palmer and John Collins on the 2nd of March. It is acknowledged that the O/D based VDM is not a preferred approach in DfT TAG and, although the benefits of P/A over O/D in the context of the A582 scheme are likely to be modest, a decision has been made to produce a P/A based VDM for the CLHTM. This will minimise risks of the A582 scheme not passing DfT assurance and will make the model future proofed for further assessments in line with TAG.

This note aims to address the DfT concerns and sets out a revised methodology for the Variable Demand Model (VDM) and P/A based forecasting to assess the A582 scheme.

3. VDM Method

3.1 The Choice Model

A Variable Demand Model will be created in line with guidance in TAG unit M2 and will be subject to realism testing to ensure that the demand model predicts the changes within acceptable margins. An incremental hierarchical choice model will calculate the changes of travellers liable to make travel choice based on change in travel costs. The choice mechanisms will be:

- The destination of any given trip.
- The generation or loss of trips.

It is expected that mode choice will not be required at this stage as it has been shown that the change in highway costs due to the A582 scheme are unlikely to cause significant modal shift. The modal shift significance test previously undertaken for the Preston Western Distributor (PWD) scheme using Census JTW data as mode split evidence confirmed that for the 97% of the movements the modal impact is insignificant as per the TAG criteria. The modal shift significance test will be re-run for the A582 scheme using the changes in travel cost from the previous model to inform the final decision on the inclusion of mode choice.

We propose not to include Time of Day choice in the variable demand model as there is not expected to be strong cost differential between time periods caused by the scheme.

In the incremental VDM all changes in travel costs are made relative to the Base Year model and the travel demand is adjusted accordingly. Cost damping may be applied if needed for longer distance trips which are less sensitive to changes in cost. The variable demand model will be calibrated in accordance with the guidelines in WebTAG unit M2 Section 5. As detailed in WebTAG Unit M2 Section 5.6.14, the parameters during calibration will be within the range of ±25% of the median value and anything outside this range will be further examined. The variable demand model will make use of the value of time (VoT) from the current version of the WebTAG data book.

The VDM will be developed in DIADEM 6.3. Matrix format (24h P/A and O/D) is discussed in the subsequent sections of the note.

3.2 Segmentation

Demand segmentation by user class will follow the segmentations outlined below. The choice model will operate using three segments (Commute, Business, Other) according to journey purpose. The underlying reason for this, as discussed in WebTAG Unit M2 is that the sensitivity of the model is likely to be different for various trip purposes and other segments

Consequently, the sensitivity parameter is likely to be numerically larger when there is more freedom to choose. The choice model will be undertaken using Production Attraction (PA) matrices for the Home-Based purposes and Origin Destination (OD) matrices for the Non Home Based matrices.

Table 2.1 : Demand Model Purposes

ID	Demand Model Purpose	Demand Model Type	User Classes	Vehicle Class
1	Home Base Work	PA Doubly Constrained	UC1	VC1
2	Home Based Employers Business	PA Singly (production) Constrained	UC2	
3	Non Home Based Employers Business	OD Singly (origin) Constrained		
4	Home Based Other	PA Singly (production) Constrained	UC3	
5	Non Home Based Other	OD Singly (origin) Constrained		
6	Light Goods Vehicles	Fixed	UC4	VC2
7	Heavy Good Vehicles	Fixed	UC5	VC3

3.3 Aspects of the Variable demand model

3.3.1 Basic features of the demand model

The VDM will predict 24hr P/A person demand by home-based purpose and by mode (if applicable). 24hr P/A demand will be converted to OD demand by time period (peak period) using factors derived during the development of the base year matrix and provide the proportion of inbound and outbound trips by time period. Additionally, demand will be converted to peak hour demand for assignment on the highway network derived from counts data.

As the demand model will be based on 24hr P/A demand it has the benefit that outward and returning journeys are connected in a manner which allows consideration of the return trip cost as the basis of destination choice (and potentially mode choice) decisions. It follows standard practice in the following ways:

- Only cars will be subjected to variable demand as it is assumed that neither LGV nor HGV flows would be affected by any new scheme other than through route choice.
- Trips to/from, within and crossing the study area trips will be set up as cost responsive in the demand model and other External to External trips would be non-responsive. The HGV and LGV demand will be treated as fixed demand.

- For the future year core scenarios, the Do Minimum and Do Something forecasts will pivot off the base year cost scenarios.
- Time of day choice will be excluded from analysis, with proportions applied to determine no. of trips per time period (how these proportions are determined is described below).

3.3.2 Base Year 24hr P/A Demand

Base year 24hr P/A car demand has been created using the methodology as described in the CLTHM Model Base Year Revalidation Methodology note. The method starts from the development of the prior matrices in the daily PA form. Then TEMPRO phi factors have been applied to convert these matrices in the required O/D format for the assignment.

As part of model calibration of the highway model the O/D matrices have had sector to sector factors applied to them to improve validation of the matrices at the screenline level. Finally, matrix estimation has been applied to improve model validation at the link level.

The CLTHM matrix totals (by purpose) and trip length distribution were closely monitored in model calibration to ensure that modifications did not significantly distort the matrices.

In order to improve the consistency of travel pattern between the 24hr PA demand that will be used as a pivot point in the variable demand model and the final calibrated O/D time period matrices, the impact of the sector to sector factor adjustments will fed back into the 24hr P/A matrices. To allow the reconciliation of changes, the calibrated O/D matrices (split by journey purpose and time of day) will be factored up to represent the modelled period and split by direction travel (from home/return home/non home based) based upon proportions in the original pre calibrated matrices. These segments from each time period will then be combined and converted to P/A.

Once the factors have been applied, checks will be undertaken on the adjusted 24hr P/A matrices. It will be compared against the original 24hr P/A matrix and the comparison of trip ends totals vs NTEM and trip length distribution from NTS, as in the original development of the 24hr P/A matrices.

The factors will then be reviewed for each demand segment to improve fit to NTEM and NTS data. Options are to adjust P/A to O/D factors at the sector level by reasonable amount (within +/- 10%), to account for local differences not accounted for in the phi factors. In addition, reasonable adjustments can be made to car occupancy and peak hour factors at the sector to sector level to improve model fit.

As the matrix estimation work is well advanced now, we are not proposing the refinement of the prior matrices a as part of this process. Instead, we will focus on minimising the differences between the final calibrated matrices and the 24hr PA demand that will be used in the incremental VDM. We assume that 2-3 iterations/rounds of adjustments will be necessary to minimise the differences in the demand matrices. The remaining matrix estimation deltas will be applied as delta matrices during the VDM process as explained below.

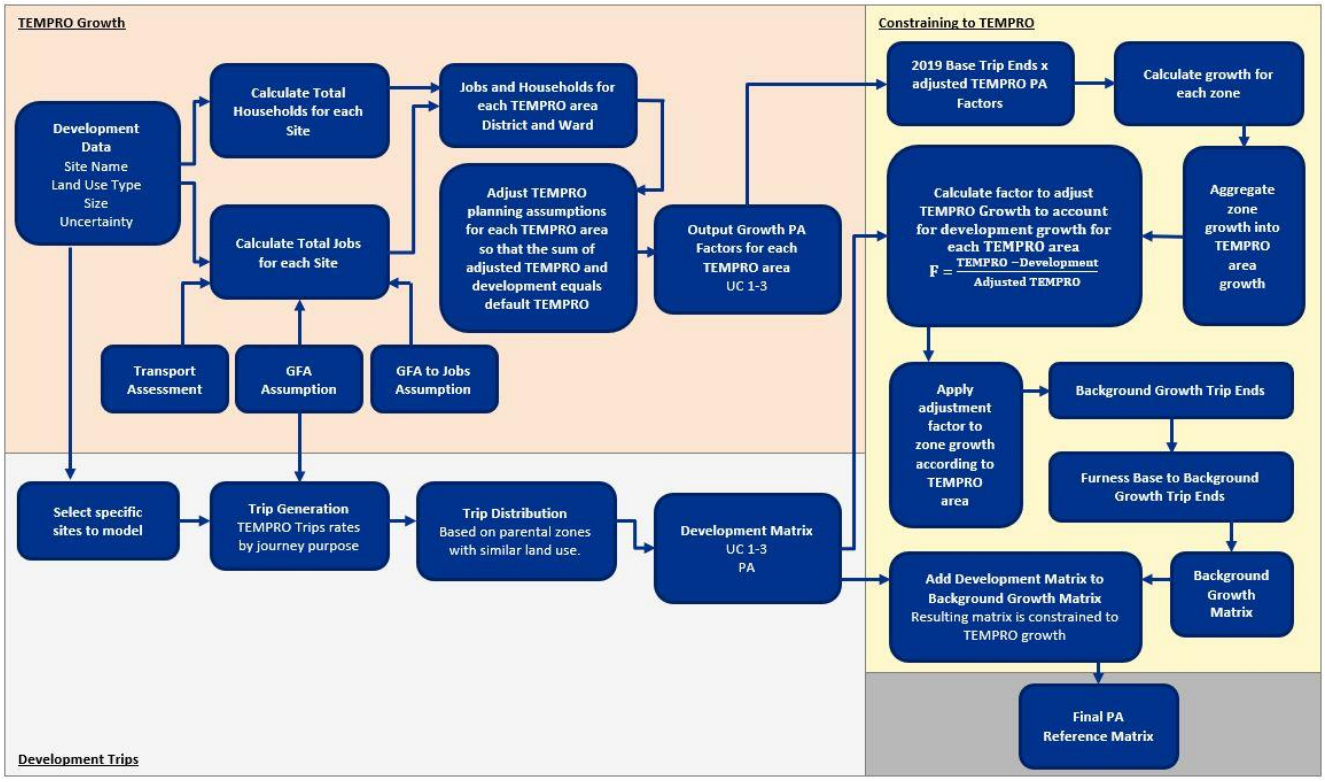
3.4 Applying the Variable Demand Model and Forecast Year P/A matrices

The VDM will predict 24hr P/A person car demand by home-based purpose. To convert from 24hr P/A demand to OD demand by time period (peak period) factors determined in the model calibration will be used to provide the proportion of from home and return home trips by time period. Additionally, demand will be converted to peak hour vehicle demand for assignment on the highway network.

The underlying approach to forecasting is one which incorporates the forecast related demand changes into the 24 hour patterns and then runs the VDM. Differences between base matrices and the forecast VDM matrices are then calculated at OD level. These changes are applied to the base year OD demand matrices to form the assignment matrices. Under this approach, the change in demand between the base year and forecast OD demand will then be applied to the validated base year car OD matrices and then assigned to the forecast highway network.

WEBTag indicates that the change may be applied as a multiplicative or additive change, but both methods have flaws depending on the size the differences between the prior and validated matrices. It has been shown that amount of change in the matrices caused by matrix estimation has been shown to be small indicating either method could be applied successfully.

The 24hr P/A input matrices to the forecast year will based upon the base year demand with TEMPRO growth applied plus trips scheme relevant large developments at a zonal level. The flow chart shows the steps for producing reference case car matrices.



4. Summary and Conclusion

The proposed methodology builds on the previous experience of developing a P/A based demand models and is driven by the current status of the model update (i.e. calibrated base year assignment model). A combination of two methods proposed in TAG will be used to reconcile the 24h P/A and calibrated O/D. The forecasting will be done in P/A as shown in the flowchart.

DfT approval is required to progress in line with the proposed methodology.