PRISM Data Summary Report

PRSIM 4.5

February 2017

PRISM Management Group
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February 2017

PRISM Management Group
# Issue and revision record

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1 Introduction

1.1 Overview

The Policy Responsive Integrated Strategy Model (PRISM) is a multi-modal disaggregate demand model of the West Midlands Metropolitan Area. The model comprises separate highway and Public Transport (PT) assignment models linked together with a demand model. The clients are the seven Metropolitan districts of the West Midlands, Highways England and Transport for West Midlands.

PRISM was originally developed to represent a 2001 base year and was later rebased to 2006. In 2009 and 2010, Mott MacDonald (MM) consulted with a range of stakeholders including Metropolitan Authorities, the Highways Agency, Shire Authorities, Department for Transport (DfT), West Midlands Regional Assembly, Government Office for the West Midlands and Birmingham International Airport. The purpose of this scoping exercise was to establish the requirements of a new model to replace the existing 2006 base year model. Subsequently, Mott MacDonald was commissioned to develop a 2011 base year model, addressing some of the issues such as including improved junction coding and a public transport model for the PM peak. That work resulted in a new PRISM model (with 2011 base year), with reporting finishing 15th May 2015. For the duration of the report that will be referred to as PRISM 4.1.

Following on from subsequent application work, a number of improvements to the model system were identified which led to the development of PRISM 4.5, briefly these can be summarised as:

- PRISM 4.1 PT assignment were headway-based and used VISUM 12.5, which can lead to some unrealistic cost changes between a do-minimum and do-something test scenario. In particular it was found that sometimes network improvements produced output costs quantifiably worse which in turn made scheme appraisal very difficult.
- PRISM 4.5 is timetable-based and uses new functionality that we specifically requested in VISUM 15, to address this issue
- PRISM 4.5 demand model has been re-calibrated using more data to better represent sub-mode choice between rail and metro.
- PRISM 4.5 PT assignment demand is now segmented by PT sub-mode (bus, metro, rail)
- PRISM 4.5 demand forecasts can now account for new park and ride (and kiss and ride) stations.
- PRISM 4.5 highway assignment includes observed signal timings, which lead to more realistic delays.
- PRISM 4.5 highway assignment convergence is much more stable, which is important for economic appraisal. PRISM 4.5 base year matrices now include journey-to-work data derived from the 2011 census which had not been previously made available.

The PRISM 4.5 update was completed July 2016, reporting work has been delayed due to work on the PRISM 4.6 update.

The purpose of this report is to summarise the transport surveys and other data collected and used for the development of the PRISM 4.5 2011 base year highway assignment, public transport (PT) and the variable demand model. There are four other reports that cover the more extensive data collection exercises in detail and are as follows:

- Data collection:
  - PRISM Surveys 2011: Household Travel Survey (Mott MacDonald, November 2012)
  - PRISM Surveys 2011: Public Transport (Mott MacDonald, November 2012)
  - PRISM Surveys 2011: Roadside Interviews (Mott MacDonald, November 2012).
These reports can be downloaded from the PRISM website: www.prism-wm.com.

For information on the more technical aspects of the model development, please refer to the other PRISM v4.5 reports:
- PRISM 4.5 Local Model Validation Report
- PRISM 4.5 Forecasting Report
- PRISM 4.5 Data Summary Report (this report)

1.2 Structure of this Report

The rest of this report provides a summary of the data used in developing PRISM. These sections are broken down as follows:
- Purpose;
- Summary; and
- Further Information (where relevant).
2 PRISM Data

2.1 Highway Assignment Model

2.1.1 Roadside Interview Surveys

2.1.1.1 Purpose

Data from the Roadside Interviews (RSIs) was collected to obtain observed information on travel patterns. Data from these surveys was merged together using ERICA software to form the RSI highway trip matrices for the model (by time period). The overall highway trip matrix is a merge of the various components that treats RSI matrices as the most reliable component, with all the other data sources used to strengthen the observed matrix.

2.1.1.2 Summary

Roadside Interviews were conducted at all sites and only in one direction from 07:00 – 19:00 on a single weekday. The surveys started in March 2010 and continued until September 2012.

A total of 76 roadside interview locations were identified related to the following screenlines:
- Birmingham and Black Country cordon;
- M5 / M6 screenline; and
- M6 (east of M5) screenline.

A total of 95,288 interviews were collected of which 86,248 were considered to be clean records and appropriate to be used for traffic modelling.

Manual Classified Counts (MCC) were conducted at all 76 sites. Over the 12 hour survey period a total of 663,618 vehicles were recorded. This equated to a total sample rate of 14.4% over the entire RSI cordon, with a 13% clean sample rate. The aim for the RSI surveys was to achieve a minimum 10% sample rate per site or a minimum of 960 interview surveys per site (80 interviews per hour over 12 hours).

RSI records were processed into a common format and inconsistent and illogical records were eliminated from the data (including missing or incomplete data, illogical origins and/or destinations and outbound and/or return travel times), representing around 9% of all records. This reflects the fact that the majority of the interviews completed were post-back questionnaires rather than face to face interview.

To further expand the dataset, data from 14 RSI sites within and around Coventry were provided by Coventry City Council. This data was collected between 2008 and 2009.

An overview of all RSI interview sites used for PRISM is shown below, in Figure 2.1.
2.1.3 Further Information

Further information can be found in the following reports which can be downloaded from the PRISM website, www.prism-wm.com:
- Road Side Interview: [PRISM Surveys 2011: Roadside Interviews].

2.1.2 Urban Centre Car Park Surveys

2.1.2.1 Purpose

To supplement the observed data in the RSI matrices, data was collected from car parks in urban centres to form car-park matrices that would contain intra-sector movements (movements that would be too short to cross an RSI cordon). A decision was made to collect origin destination data in off-street car parks only because when data was collected previously, only a very small sample of on-street data was obtained (so not cost effective to collect).

2.1.2.2 Summary

The surveys were undertaken in off-street car parks at the following centres:
- Birmingham;
- Solihull;
- Sutton Coldfield;
- West Bromwich;
- Coventry;
- Walsall;
- Brierley Hill;
- Merry Hill;
- Wolverhampton; and
- Dudley.

**Figure 2.2:** Location of urban centre car park survey sites

The surveys were carried out during the neutral months of March, September, October and November in 2010 and 2011.

To act as a control to test weighting procedures, a sample of on-street surveys for 2011 was undertaken. Wolverhampton was chosen to undertake this control survey, due to the relatively high number of on-street parking spaces within the central area. Post-back questionnaires were chosen as the method of data collection for the car park surveys due to the large volume of people that would need to be interviewed.

Across all areas the total number of questionnaires issued was 28,980 (approximately 62% of the traffic counted). The total number of clean questionnaires returned was 4,663 (approximately 16% of those issued and 10.1% of the traffic counts).

2.1.2.3 Further Information

Further information can be found in the following reports which can be downloaded from the PRISM website, [www.prism-wm.com](http://www.prism-wm.com):
2.1.3 Trafficmaster GPS Road Traffic OD Matrices

2.1.3.1 Purpose

Observed matrices from survey data are generally accepted by the industry as the most reliable component of any transport matrix, however by their nature they produce very sparse matrices (for PRISM only ~3% of Origin and Destination (OD) pairs are non-zero in the RSI car matrices).

For this project new observed data from Trafficmaster (TM) GPS (Global Positioning System) trackers was made available by the DfT which was to be used to supplement the observed data from traditional roadside and car park surveys.

2.1.3.2 Summary

The GPS data is available from vehicles belonging to TM customers who are currently believed to be primarily high mileage private vehicle drivers and company car drivers. In 2011 there were approximately 60,000 vehicles fitted with TM devices within the UK. The DfT was able to provide data in matrix format – showing:
- Origin and destination (PASS3) zone;
- Time of travel (trip start); and
- Vehicle type (Car, LGV, HGV).

The Pass3 zoning system covers the UK in roughly 10,000 zones – which are generally larger than PRISM zones within the core area of the model and generally much smaller than PRISM zones outside of this area.

The OD coverage\(^2\) of the data was 57% for Car, 62% for LGV and 9% for HGV.

This observed distribution was used to add richness to the demand matrix, whilst treating the totals observed by traditional surveys (RSIs) as the most reliable.

2.1.4 INRIX GPS Road Traffic OD Matrices

2.1.4.1 Purpose

Whilst the TM GPS data provided valuable movement information, the HGV coverage was poor, so additional GPS data was bought from INRIX containing improved HGV coverage.

2.1.4.2 Summary

INRIX data was provided within a 30 mile bounding box centred on Birmingham, completely covering the fully modelled area. Trips of a longer nature were still captured, however the start and end point of the trips was curtailed to the edge of the bounding box.

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\(^{2}\) By OD Coverage, we mean the percentage of OD cells in the 12hr matrix that are non-zero (AM + IP + PM), rounded numbers provided.
Information provided included:
- Origin and destination (PASS3) zone; and
- Time period of travel (trip start).

The OD coverage\(^3\) of the data was 14\% for HGV, creating a much richer distribution than would be otherwise possible.

### 2.1.5 PRISM Synthetic Car OD Matrices

#### 2.1.5.1 Purpose

To further supplement the matrix build, data from synthetic matrices were used. The synthetic matrix was taken from the PRISM 4.1 demand model that had been updated to reflect travel behaviours observed in the 2009-11 household interview data (see section 2.3.1). Whilst not directly observed the data is still very useful in producing a robust trip distribution covering over 99\% of OD cells.

#### 2.1.5.2 Summary

Land use assumptions that fed the demand model were revised with recently updated datasets such as educational enrolment data and employment data aggregated from the Inter-Departmental Business Register (IDBR) and data available from the 2011 Census including recession impacts.

### 2.1.6 Census 2011 Journey to Work Matrices

#### 2.1.6.1 Purpose

To further supplement the matrix build, the 2011 national Census was used an additional data source.

#### 2.1.6.2 Summary

The Census data provides records aggregated to MSOA zones, these records contain home address and usual place of work. Using trip rate information derived from the West Midlands Household Interviews (see 2.3.1) this information was converted into an all-day tour matrix. This was further disaggregated into PRISM zones and into time periods using local data.

This information was used to supplement the commute-purpose trips in the highway and public transport matrix build.

### 2.1.7 Road Traffic Counts

#### 2.1.7.1 Purpose

Traffic counts were used for three main purposes in the model development:
- Matrix expansion (e.g. of RSI records);
- Model Calibration; and

---

\(^3\) By OD Coverage, we mean the percentage of OD cells in the 12hr matrix that are non-zero (AM + IP + PM), rounded numbers provided.
Model Validation.

A variety of sources were used to obtain traffic count data, ensuring a large data set was available.

2.1.7.2 Summary

Most of the traffic counts used were Automatic Traffic Counts (ATCs) and came from Spectrum. Spectrum is a database of traffic count data collected within the West Midlands and maintained by Mott MacDonald. Traffic count data for roads within the area of detailed modelling were extracted from Spectrum using the following conditions:

- Data is from an ATC;
- The survey was undertaken between 2010 and 2012; and
- The survey lasted one week or more.

Screenlines and cordons were checked for any data gaps on roads considered to be of strategic importance. As a result, 23 new one-week ATCs were undertaken within the Area of Detailed Modelling in October and November 2012.

Some traffic counts were collected alongside the Roadside Interviews described in section 2.1.1 above.

Manual classified counts (MCCs) were compiled for all 90 RSI sites. The MCCs were used primarily to expand RSI records to expansion factors at 30 minute intervals. Each MCC included the following details:

- Counts for Car, LGV, HGV, Taxi, motorcycle;
- Counts in 15 minute intervals; and
- Classified counts processed into 30 minute intervals.

Each of the RSI sites had an ATC (generally over a two-week period) which was used in the data expansion process during the matrix build. Permanent ATC counts have also been used to adjust records to an annual average weekday.

In some cases survey data was from different years, e.g. RSI data for Coventry is from 2008 and 2009. These were adjusted to a common year of 2011 using seasonality factors based on analyses of permanent ATC sites within the West Midlands.

2.1.8 Historic PRISM Road Network

2.1.8.1 Purpose

Rather than begin building the networks from scratch, the network from the previous version of PRISM was used as a starting point. For PRISM 4.5 the validated networks from PRISM 4.1 were used as the starting point.

2.1.8.2 Summary

The original networks were constructed to cover all Motorways, A and B roads and all other roads that carry significant traffic volumes.

2.1.8.3 Further Information
The LMVR for the previous version of PRISM (v4.1) is available from the PRISM website. The PRISM 4.1 networks were in turn based on the network in the previous version of PRISM (v3.2), and so that LMVR may also be of interest, and is available from the PRISM website, www.prism-wm.com:

- PRISM version 4.1 LMVR: [PRISM Local Model Validation Report (15.05.2015)]
- PRISM version 3.2 LMVR: [PRISM v3.2 – 2006 Gamma Model Development and Local Model Validation Report (March 2011)].

2.1.9 NAVTEQ Road Network

2.1.9.1 Purpose

In order to better reflect the road network in 2011, data from NAVTEQ Maps data (Q4, 2011) was used to code speed limits and to check the number of lanes on links within the Fully Modelled Area. NAVTEQ was a provider of GIS data and of base electronic navigable maps.

2.1.9.2 Summary

NAVTEQ data was supplied in the form of a VISUM network and contained information on links, layout, speed and number of lanes. However, it did not contain detailed junction coding. The LMVR contains more detail on junction coding.

2.1.10 Integrated Transport Network (ITN)

2.1.10.1 Purpose

In order to update the 2006 PRISM network to reflect the road network in 2011, the Ordnance Survey (OS) Master Map® Integrated Transport Network (ITN) dated August 2011 was used to inform the coding of updated link and junction layouts within the Fully Modelled Area.

2.1.10.2 Summary

The Ordnance Survey Master Map® Integrated Transport Network is a commercially available mapping layer used in many transport projects.

OS MasterMap Topography Layer provides a highly detailed view of Great Britain's landscape including individual buildings, roads and areas of land and water. In addition to the polygons, points and lines that are structured to represent real world features, it is a richly attributed dataset and includes a unique identifier for each feature which is known as a Topographic Identifier (TOID).

Motorways, A roads, B roads, minor roads, local streets and private roads – all are captured to an exacting specification.

The ITN Layer catalogues over a million banned turns, one-way streets, time or vehicle-based restrictions.

2.1.10.3 Further Information

2.1.11 Google Maps/Earth

2.1.11.1 Purpose

For the majority of junctions, aerial photography from Google Maps was used to obtain information on junction layout and operation. Where aerial imagery may have been out of date (the date stamp of the image was earlier than 2010/2011), junction details were obtained by using site layout drawings, undertaking site visits or, in a few cases, liaising with Local Authorities.

2.1.11.2 Summary

Although we are not licenced to use such imagery in reports, observing the imagery in order to make judgements is permissible.

2.1.12 Bus Lane Information

2.1.12.1 Purpose

Bus lanes are represented in the PRISM HAMs via a reduction in capacity and number of lanes on affected links.

2.1.12.2 Summary

Bus lane plots for each of the seven districts (data from 2008) were provided by Centro and were used as a starting point for coding bus lanes in the PRISM HAM. Each of the routes in the plots was examined using Google Maps with links annotated in the model and a reduction in highway capacity coded.

2.1.13 Road Traffic Signal Specifications

2.1.13.1 Purpose

The Intersection Capacity Analysis (ICA) module within VISUM has been used in conjunction with an equilibrium assignment to model junction delay within the Area of Detailed Modelling. In order to correctly model a junction using ICA, it is necessary to specify junction geometry, including the number of lanes per approach, the permissible turns per lane, and the number of flared lanes. Additionally for any junction that uses traffic signals, information on the signal staging and timings are required.

2.1.13.2 Summary

Signal specifications were provided by the seven metropolitan authorities for the majority of signalised junctions within the Area of Detailed Modelling. Each signalised node was coded with basic staging arrangements as provided in the signal specification.

Whilst signal specifications do contain minimum and maximum green times, it is not possible to obtain actual timing data from the signal specifications. Instead, this data must be collected either on site or through control centres.
2.1.14 Observed Signal Timing Information

2.1.14.1 Purpose

In PRISM 4.1, signalised junctions had been identified as one of the causes of convergence issues in the network affecting scheme appraisal. For PRISM 4.5, it was agreed that observed signal timing information would be input into the model.

2.1.14.2 Summary

Traffic signal timings were collected for each signalised junction within the PRISM model through liaison with the relevant local highway authority. The councils at Birmingham, Coventry, Sandwell, Solihull and Wolverhampton each have dedicated Urban Traffic Control (UTC) centres. Traffic signals in Walsall and Dudley are operated through Wolverhampton’s control centre.

Wherever possible, the timings were based on recorded data. This was possible wherever the junction was connected to the local Urban Traffic Control (UTC) centre or where the junction operated on MOVA (Micro-processor Optimised Vehicle Actuation) control. The signal timings collected were stage based rather than phased based, giving stage and inter-stage times. The inter-stage times were calculated from the traffic signal controller specification for each junction.

For junctions that did not have recorded signal timings available, or where the recorded data was clearly incorrect, the stage times were calculated using the maximum green times in the controller specification. These green times are the maximum time that the controller will allow the signal to be on green when operating under VA (Vehicle Actuation) control. Whilst these are unlikely to be the actual signal times, they are likely to give reasonably realistic green splits between stages. In other words, the green time is divided proportionally between stages based on the amount of traffic demand for each stage.

For some junctions where no data was available (or the data seemed implausible and caused calibration issues), the signal timings have been estimated using VISUM inbuilt tools and local knowledge. Plots showing the signals in the model and their data sources (and whether they have been estimated) are available in the LMVR and LMVR appendix.

2.1.15 M6 Toll Charges

2.1.15.1 Purpose

Within the route-choice element of the VISUM highway assignment, a toll cost is modelled on the M6Toll. The value that went into the model was calibrated to better reflect the perceived cost to drivers so that a realistic traffic flow assignment was obtained.

2.1.15.2 Summary

The M6 Toll charge used in the demand model was based on March 2011 prices, provided by Midland Expressway Ltd. These prices for individual vehicle class and terminal type are summarised in Table 2.1 below.
Table 2.1: Actual cost of the toll in 2011

<table>
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<th></th>
<th>Car</th>
<th>LGV</th>
<th>HGV</th>
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<tr>
<td>Main Plaza</td>
<td>£5.30</td>
<td>£10.60</td>
<td>£10.60</td>
</tr>
<tr>
<td>Local Plaza</td>
<td>£4.00</td>
<td>£10.00</td>
<td>£10.00</td>
</tr>
</tbody>
</table>

Source: Midland Expressway Ltd

The value that went into the model was calibrated to better reflect the perceived cost to drivers, and this was found to be 25% of the true cost, so a flat factor has been applied.

2.2 Public Transport Assignment Model

2.2.1 Public Transport Surveys

2.2.1.1 Purpose

In order to create base year demand matrices for the Public Transport Assignment model, observed data from traditional surveys was required (and subsequently treated as the most reliable component of the matrix build).

2.2.1.2 Summary

Centro and Mott MacDonald developed a programme of passenger origin-destination surveys over the period 2009 to 2011. These surveys (comprising of passenger interviews and counts) were conducted at main, local and district centres across the West Midlands. The surveys were conducted at stops to include bus, rail and Midland Metro passengers.

Centro has a rolling programme of annual surveys for this purpose. With the PRISM refresh it was possible to extend the coverage of this programme by pooling resources.

On the basis of the prioritisation, and making full use of resources available, 18 centres across Birmingham and the Black Country were selected as survey locations (as shown in the diagram below).

No surveys were conducted in Coventry as a significant data collection exercise had been conducted to develop base year matrices for the 2008 Coventry/Warwickshire public transport model. These matrices formed an input to the prior matrix.

Centro have historic survey data from OD matrix surveys carried out prior to the PRISM refresh programme. These were conducted between 2005 and 2009, also being informed by the prioritisation approach outlined above. They were converted to the 1900 zoning system from the 1418 former Centro zoning using correspondence files agreed between Centro and Mott MacDonald. This fed into the survey matrix build along with the new survey matrices collected for the PRISM refresh.
2.2.2 Historic Public Transport OD Matrices

2.2.2.1 Purpose

The approach adopted by Centro in building public transport matrices made use of existing demand matrices from earlier models, applying lower confidence to the data to act as infill data where survey matrices or synthetic data was weak.

2.2.2.2 Summary

Data for these matrices came from two models: Centro 2005 Birmingham / Black Country base year model and the 2008 Coventry / Warwickshire model. The latter owned jointly by Centro and Coventry. The spatial coverage of these two models overlaps in the Solihull area, where there is a correspondence between the two zoning systems as the Coventry model uses the Centro zoning system. A process was established which joined the two matrices together, taking the demand from the model for which each OD pair movement will have the highest confidence (i.e. Birmingham city centre to Solihull from the Birmingham / Black Country model) and removing double counting.

2.2.3 PRISM Synthetic Public Transport OD Matrices

2.2.3.1 Purpose

In order to help infill OD movements that are not observed in traditional surveys, the synthetic matrix was used as an additional component in the matrix merge.
The PRISM 4.5 matrix build was carried out using the same methodology as with PRISM 4.1 (as CENTRO had carefully calibrated it during the PRISM 4.1 build). For that process the total number of trip matrices was fixed, and not disaggregated by purpose. In order to make use of the Census data, the PRISM synthetic matrix was merged at the purpose level with the Census data before being aggregated up ready for processing the matrix build.

2.2.3.2 Summary

For more details on the synthetic matrix compare section 2.1.5, also see 2.1.6 for details on the Census matrix data.

2.2.4 PLANET Long Distance PT OD Matrices

2.2.4.1 Purpose

The synthetic and observed data does not represent through-trips by public transport for those trips with either a single, or both trip ends outside the core model area. In order to represent these passenger flows PLANET Long Distance (PLD) matrices were used. HS2 PLANET data was used for the purposes of maintaining consistency with the HS2 forecasts for modelling local HS2 impacts.

2.2.4.2 Summary

Demand matrices and link flows for a 16-hour period were provided from the PLANET Framework Model v4.2 2011 base year. A number of adjustments were made in order to derive time periods and to convert the demand to the new zoning system.

The factors used to convert from all day matrices were derived from local Birmingham city centre cordon count data collected at city centre stations. A mask was also applied to filter-out trips which would not travel through the modelled area. This is because PLANET is a national rail model which includes flows not taking place within the modelled area.

2.2.4.3 Further Information

Information regarding the PLANET model can be found here:
- [http://assets.hs2.org.uk/sites/default/files/inserts/S%26A%204_PLANET%20framework%20model%20%28PFM%20v4.3%29_model%20description.pdf](http://assets.hs2.org.uk/sites/default/files/inserts/S%26A%204_PLANET%20framework%20model%20%28PFM%20v4.3%29_model%20description.pdf)

2.2.5 Public Transport Passenger Counts

2.2.5.1 Purpose

In order to facilitate the network calibration, passenger count data for the base year was required.

2.2.5.2 Summary

Bus count data was collected from the following sources:
- LTP Bus Cordon Counts;
- Local Centre Cordon Counts;
- Origin-Destination Survey Passenger Counts;
- Bus Showcase Counts; and
- Bus Station Counts.

For rail the following sources were used:
- LTP Centre Rail Cordon Counts;
- Control Station Counts;
- Local Station Passenger Counts; and
- Park and Ride Counts.

For Midland Metro, an annual passenger count is conducted each October by Midland Metro, and this data is shared with Centro. This provides a full one day count of passengers boarding and alighting at every Midland Metro Line One stop. See the LMVR for more details on PT counts.

2.2.6 PLANET Long Distance PT Passenger Flows

2.2.6.1 Purpose / Summary

To fix the demand flows from the through-trip matrices; matrix estimation was carried out to fit the flows to the link counts taken from the PLANET Long Distance (PLD) model. Links were chosen so that a cordon was formed around the core modelled area, so that key links in central Birmingham where the flows are high in volume, were included and so that any links which are important in terms of model accuracy were included.

2.2.6.2 Further Information

Information regarding the PLANET model can be found here:
- http://assets.hs2.org.uk/sites/default/files/inserts/S%26A%204_PLANET%20framework%20model%20%28PFM%20v4.3%29_model%20description.pdf

2.2.7 Public Transport Timetable Service Data

2.2.7.1 Purpose

Bus and rail timetables are a basic requirement for the public transport assignment models as they contain all the service-specific information needed such as stop-to-stop runtimes, stopping patterns, headways, stop locations and timetables.

2.2.7.2 Summary

Timetable data was sourced from the National Public Transport Data Repository (NPTDR) which contains the timetable data for a selected week in October 2011 for every PT service in the UK. Data was filtered from this data-set so that the PT model represents trips in an average weekday. The base year models are based on the October 2011 timetables and the future year networks are based on March 2013 data.

Centro liaised with PTV, providers of the VISUM software, who have developed a tool for automating the process of building public transport networks from the ATCO-CIF data. The ATCO-CIF data contains the timetable information and the process developed by PTV takes this information to create the route.
The final product is a public transport network file, incorporating all services including bus, rail and Midland Metro. This network of services was then read into the base network after any additional stops were added.

The route information has been checked against paper timetables and journey times using the www.networkwestmidlands.com journey planner.

2.2.8 Historic Public Transport Networks

2.2.8.1 Purpose

A link and node structure including public transport ‘stop’ locations is a basic requirement for the public transport assignment models on to which the timetable information can be overlaid. For PRISM 4.5 the PRISM 4.1 network was used as the starting point.

2.2.8.2 Summary

Centro put a lot of effort in to checking the locations of stops on the link and node network from their 2005/2008 models which were originally built on the 2001 OS OSCAR road network dataset. It therefore made sense, within the AoDM, for this to be the basis of the link and node network for the PRISM public transport assignment model.

Outside of the AoDM a simple straight-line network has been constructed between stops where the co-ordinates for stops is taken directly from NPTDR.

During development of PRISM 4.1 various changes to the network made available by Centro were made (e.g. new connectors, adjusting links for calibration purposes). For PRISM 4.5 these networks were used as the starting point, rather than starting again from the older Centro model.

2.2.9 Public Transport Fares

2.2.9.1 Purpose

Public transport fares are an input to the public transport assignment models so that fares can be included in the route costs for the ‘Fare’ demand segment. Matrices of fare are then skimmed from the assignment models and fed to the demand model to be combined in to the utility functions for the calculation of demand.

2.2.9.2 Summary

The “fare” demand segment represents trips made with cash purchased tickets on the day of travel, therefore concessory travel and season tickets such as all-day fares or return fares are not taken into account for this demand segment, but are included in the “no fare” segment.

Passengers boarding a bus service pay a fee of £1.80 which was chosen as it was the National Express West Midlands price for a single ticket in 2011.
As there was only a single metro line running in 2011, i.e. Midland Metro, a complete fare matrix was provided by Centro which gives the cash fare between all stops on the line. This data was used to derive a distance-based linear regression for implementation in the assignment model.

Similar regressions were derived for rail for which a sample of fares were obtained from Centro in the form of fare matrices from London Midland, and gathered manually from www.nationalrail.co.uk.

2.3 Variable Demand Model

2.3.1 Household Interview Surveys

2.3.1.1 Purpose

The household interview (HI) data was used for the estimation of the PRISM tour-based disaggregate demand model by RAND Europe. Models have been developed for 14 travel purposes, all of which represent travellers’ choices of travel mode and destination based on the choices observed in the HI.

2.3.1.2 Summary

A household interview survey was conducted over a three year programme from June 2009 through to June 2012. Data was collected from 5,030 households with the sample made up of:

- 4,712 households sampled using a random walk method with a restriction on the number of households interviewed per street, stratified by ward within each metropolitan district;
- 150 households who also took part in the GPS-aided study, which was used to research the propensity to under report trips; and
- 168 households randomly selected from the Post Office Address File, in order to compare the average trip rate between this and the random walk sampling methodology.

A total of 13,647 individuals were observed making 31,582 trips and for each survey, information was gathered regarding the household, vehicle, person and travel diaries.

The following household information was gathered:

- Address;
- Household type (e.g. detached, bungalow etc.);
- Ownership type (e.g. owner occupied, rented from council etc.);
- Working status of the head of the household;
- Main income earner’s socio-economic group;
- Number of bicycles in the household;
- Number of motorised vehicles in the household; and
- Household gross annual income.

The following vehicle information was gathered:

- Fuel type;
- Date of vehicle registration (pre- or post-2001);
- Vehicle engine capacity and tax code;
- Annual mileage; and
Vehicle ownership (e.g. owner, employer etc.).

The following person information was gathered:
- Relationship with head of household;
- Age group;
- Ethnic group;
- Working status;
- Education level;
- Type of driving licence;
- Mobility problems; and
- Type of public transport pass held.

The following information was gathered for each trip given in the travel diary:
- Origin location and purpose;
- Destination location and purpose;
- Mode;
- Type of car parking; and
- Parking charge.

2.3.1.3 Further Information

Further information can be found in the following reports which can be downloaded from the PRISM website, www.prism-wm.com:
- HI data collection: PRISM Surveys 2011: Household Travel Survey; and

2.3.2 Socio-Demographics

2.3.2.1 Purpose

Planning data is a key input to the Population Model and a key driver to the travel patterns forecast by the Travel Demand Models. The following data is supplied to the models:
- Population: Some of the Travel Demand Models use total population as an attraction variable;
- Employment: Some of the Travel Demand Models use total employment, retail employment and service employment as attraction variables; and
- Enrolments: The education-purpose Travel Demand Models use primary, secondary or tertiary enrolments as attraction variables.
- Zonal Targets: The Population Model requires targets for each zone in the FMA, broken down in to various population strata for use in the calculation of the future West Midlands population:
  - Gender; age group; worker status; students; household type; and total income.

Further information can be found in the following reports:
2.3.2.2 Summary

Population

The 2011 population figures for PRISM zones in the AoDM were calculated from Census data for Output Areas (OAs) by apportioning based on residential Address Points (APs). Outside of the AoDM, the OA populations were attributed to the zone containing the OA centroids. All figures were then constrained to 2011 NTEM district totals to be consistent with WebTAG guidance.

Employment

Data from the Inter-Departmental Business Register was used to calculate the number of jobs within each PRISM zone in the PRISM AoDM. This was taken from an IDBR file sourced via Solihull MBC for use with the PRISM model only. Following checks on the IDBR source data, a number of changes were made to the file to amend records identified as being inaccurate. These changes relate to postcode allocation, where the headquarters postcode had been allocated but the business address was different, most notably many schools were originally given the employment postcode of the council office but the business address of the site location. For these records the postcodes were amended before allocation of jobs to PRISM zones. These figures were then constrained to 2011 NTEM district totals to be consistent with WebTAG guidance.

Outside of the AoDM, Lower-Super Output Area (LSOA) Business Register and Employment Survey (BRES) figures were used to calculate an initial number of jobs before being constrained to 2011 NTEM district totals to be consistent with WebTAG guidance.

Enrolments

2011 enrolments were derived from four key sources:

- **Department for Education Source 1**: “DfE: Schools, Pupils and their Characteristics, January 2011” – The statistical first release (SFR) based on the 2011 School Census;
- **Edubase**: Data from the Department for Education downloaded in June 2012;
- **Higher Education Statistics Agency Source 1**: “Table 1 - All students by HE institution, level of study, mode of study and domicile 2010/11”; and
- **Department for Education Source 2**: “Performance tables 2010: Key Stage 5”.

Data from the first Department for Education source (above) was combined with the Edubase source. The majority of schools appear in both lists but duplicates were removed. Any schools which opened from 1st September 2011 were not included and schools which have closed since this date were retained.

Zonal Targets

The Population Model requires population targets for each zone in the AoDM. These targets are broken down into various population strata for use in the calculation of the future West Midlands population. At the time the model was developed, the only information available at the required level of detail came from the 2001 Census and this was the starting point for developing the 2011 Zonal Targets.

To be precise, the zonal targets from the original PRISM model were used as the starting point. The data required re-zoning (to the new PRISM zoning system) before being adjusted to match the population totals for each zone that was available from the 2011 Census. The following information for each zone was therefore retained from the 2001 Census:
Gender proportions;
Age group proportions;
Household-type proportions;
Worker status proportions;
Worker-to-population ratio;
Student-to-population ratio; and
Household-to-population ratio.

An important zonal target that was not used in the original PRISM model is total household income. The following approach was used for estimating the total household income for each zone in the AoDM:
1. Take CACI household income data from 2004/5 (available from PRISM v2); and
2. Apply real increase in household income from 2004/5 to 2011 of 1.2%.

Although the 2011 census information on household breakdown was not available at the time of the demand model development (and calibration), data was later made available for use in PRISM. Consequently the final household zonal targets used as inputs for the base year and forecasts of the PRISM VDM as reported on in the PRISM LMVR and PRISM FR are based on 2011 data constrained to NTEM totals.

2.3.3 Parking Costs

2.3.3.1 Purpose

Car park costs are used in the demand model as part of the generalised cost, or (dis)utility of travelling to a particular location.

2.3.3.2 Summary

Parking cost data was collected for zones in the city centres of each of the seven districts in the AoDM. Car parks for the centres were identified using Google Maps, and then parking cost data were assembled from the online Parkopedia database.

It is emphasised that the parking cost data are for city centres only, for all other locations it is assumed that parking is free.

The parking cost information contains 2012 parking costs for stays of different durations. Some model zones contain more than one car park, and so to allow representative parking costs to be calculated, information on the total number of spaces in each car park was obtained. Average costs for each zone were then calculated as a weighted average over the car parks in that zone. The calculation of the average parking costs by zone was made by RAND Europe using the data supplied for each individual car park by Mott MacDonald.

For most zones, non-zero parking costs are defined for stays of any duration. In model estimation, the activity duration at the primary or secondary destination is used to calculate the appropriate parking cost.

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4 Office National Statistics, UKEA and Blue Book; World Database of Happiness
2.3.3.3 Further Information

Further information can be found in the following report which can be downloaded from the PRISM website, www.prism-wm.com:

2.3.4 Park and Ride parking places

2.3.4.1 Purpose

Within the demand model, rail and metro public transport usage via park and ride travel is modelled. In order to model this, the model needs to know which zones contain metro or train park and ride stops, and the number of parking spaces. Without this information the demand to/from these stations will be artificially suppressed.

2.3.4.2 Summary

An extensive exercise between MM and Centro in 2015 compared various statistics on the number of park and ride parking places. From this an agreed list of train and metro zones/spaces for 2011 and a single future scenario were agreed for 2021 and 2031. This provides the basis of modelling park and ride in the forecast core scenarios.

Data required by the model for each sub-mode (metro and train) include:
- Model zone station is in; and
- Number of dedicated parking spaces available.

After consultation with RAND, it was agreed that zones containing a station but with no dedicated spaces should be marked as containing 0 spaces, rather than being omitted from the list. This is because it is plausible someone could be ‘dropped off’ (so called ‘kiss and ride’), which is also predicted by the demand model.