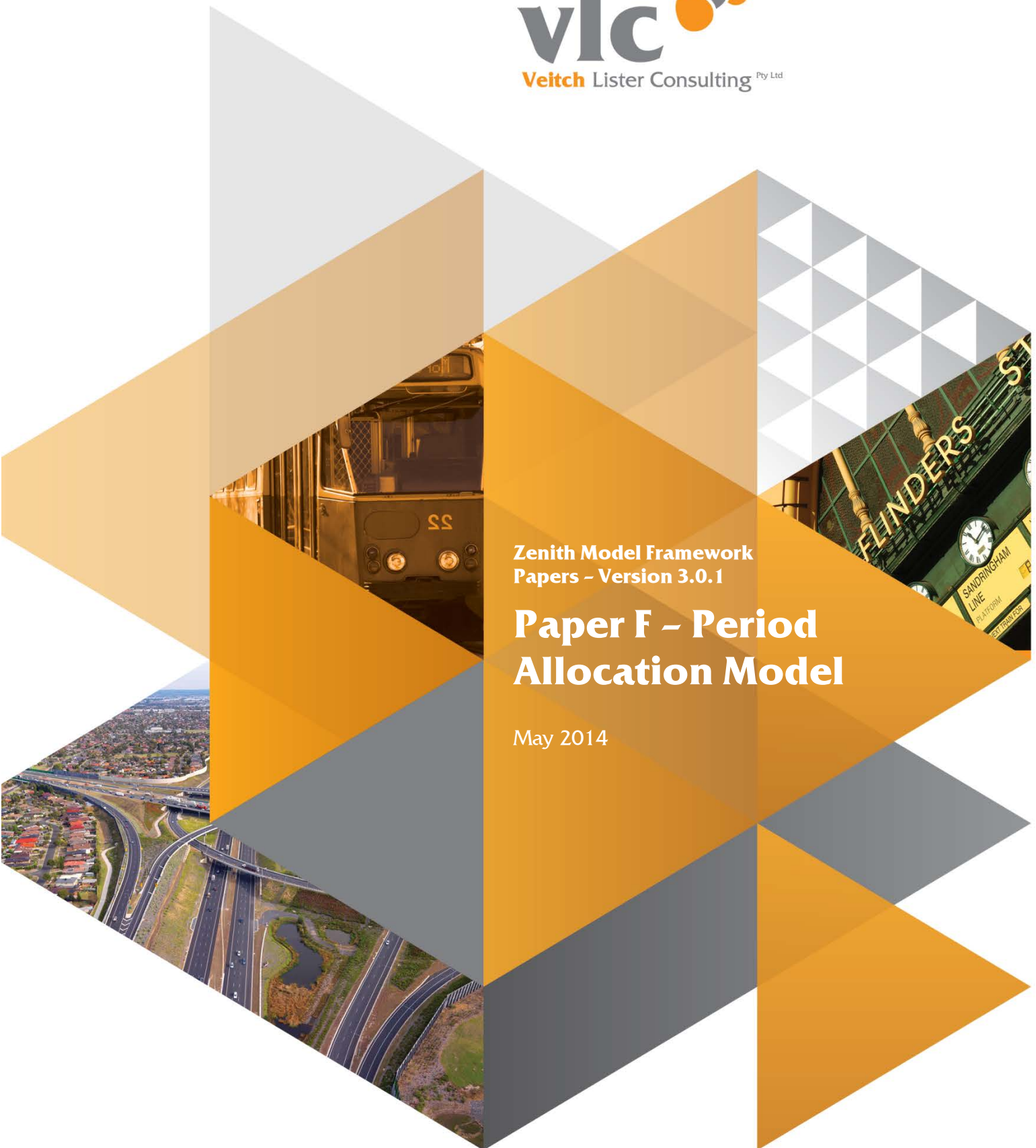# vlc
Veitch Lister Consulting Pty Ltd

**Zenith Model Framework
Papers – Version 3.0.1**

Paper F – Period Allocation Model

May 2014

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Zenith Model Framework Papers – Version 3.0.1

Paper F – Period Allocation Model

Draft Report

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04/04/2014	A	TV	JC	TV	Draft Report
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Executive Summary

The Zenith Models are a family of four step transport models, developed by Veitch Lister Consulting (VLC) and implemented in the OmniTRANS software package for a range of Australian cities and regions. This document is one in a series of working papers that collectively describe the model structure and framework of the Zenith Model; in particular, this document describes the Period Allocation Model.

The aim of the Period Allocation Model is to estimate the proportion of total daily trips, for a particular purpose, which will occur in a particular time period. The time periods used vary by model, for example the Victorian model uses:

- AM Peak
- Inter Peak
- PM Peak
- Off Peak

Separate Period Allocation factors are estimated for each trip purpose. In some circumstances the purposes are further divided into separate production or attraction regions, for example:

- The CBD Core (the densest and most central part of the CBD);
- The CBD Non-Core (the remainder of the CBD); and
- Non CBD (all other areas)

This division by region is only performed when travel behaviour (in terms of period choice) for a particular purpose shows significant variation by production or attraction destination.

Contents

List of Figures

List of Tables

v

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1   Introduction

This Technical Note is one of a series of papers that collectively describe the Zenith Transport Model. Zenith is a four step transport model, implemented in the OmniTRANS software package for a range of Australian cities and regions.

This document focuses on the methodology of the Period Allocation Model, and does not include parameter estimates for specific regions. Information about parameter estimates can be found in the region specific technical notes relating to Period Allocation (located at http://zenith.veitchlister.com.au).

For further information, please contact our research and development team at zenith@veitchlister.com.au.

2   The Period Allocation Model

2.1   Context and Objectives

The Period Allocation Model is the fifth step in the Zenith Model Run process, and follows the Destination Choice Model, as illustrated in Figure 1 below.
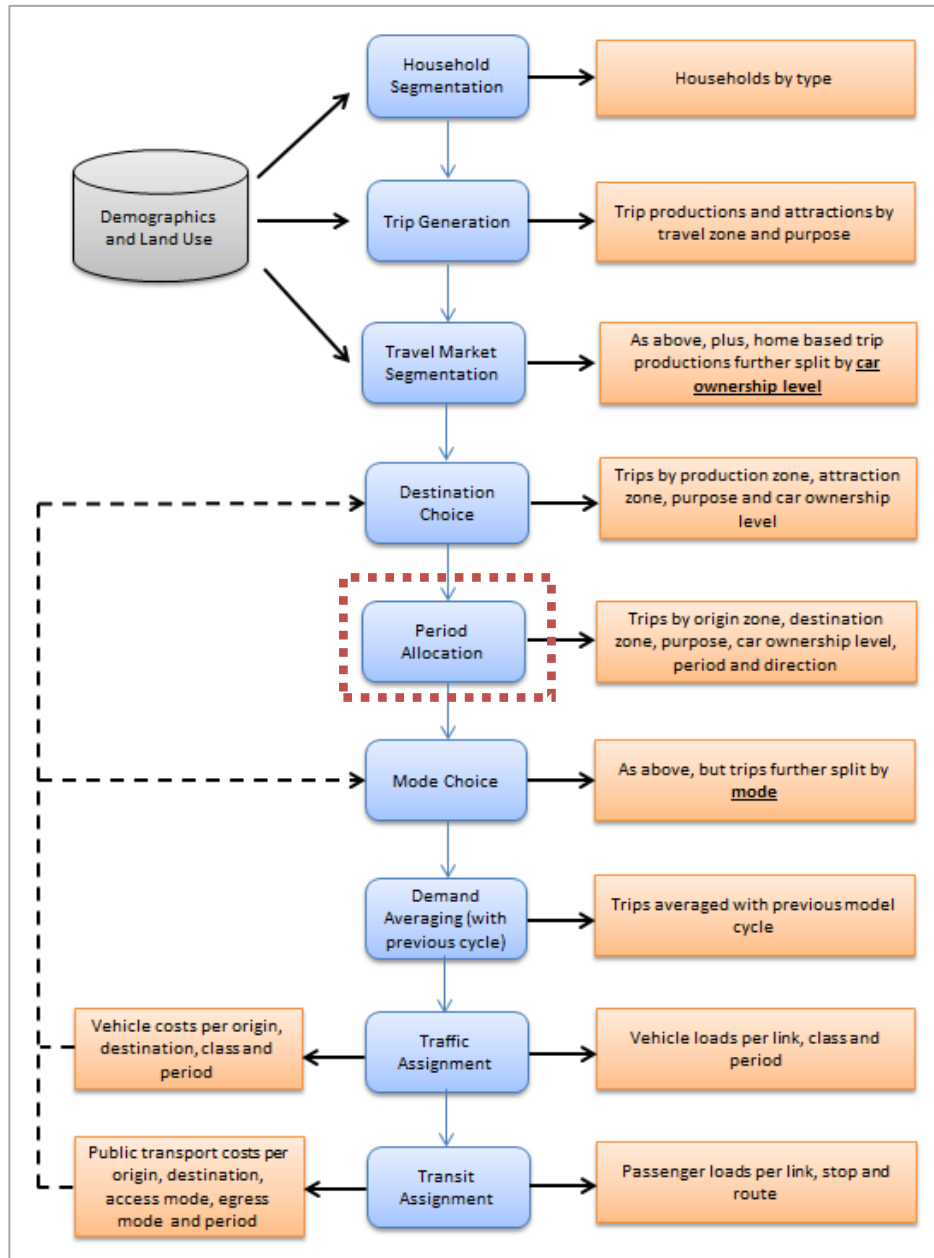
Figure 1: Zenith Model Run Process

The Period Allocation Model takes as input trips by origin / destination by travel market segment which are output from the Destination Choice Model. These trips do not yet have an assigned period, and they are all assumed to occur in the Outward (production to attraction) direction (e.g. home to work).

The aim of the Period Allocation Model is to assign both a period and a direction to each trip.

2.2 Periods and Directions

Most Zenith models divide the 24 hour day into three mutually exclusive periods, defined as follows:

- AM Peak: 7 to 9am
- PM Peak: 4 to 6pm
- Off Peak: The remainder of the day

The exceptions are the Victorian and ACT models, which divide the day into four periods:

- AM Peak: 7 to 9am
- PM Peak: 4 to 6pm
- Inter Peak: 9am to 4pm
- Off Peak: 6pm to 7am

All Zenith models also assign travel to one of two directions:

- Outward
- Return

The concept of directionality is detailed in the following sub-section.

The aim of the Period Allocation Model, as discussed in the previous section, is to assign each trip both a period and a direction.

For a model with 3 periods, this leads to the assignment of trips to 6 period / direction combinations:
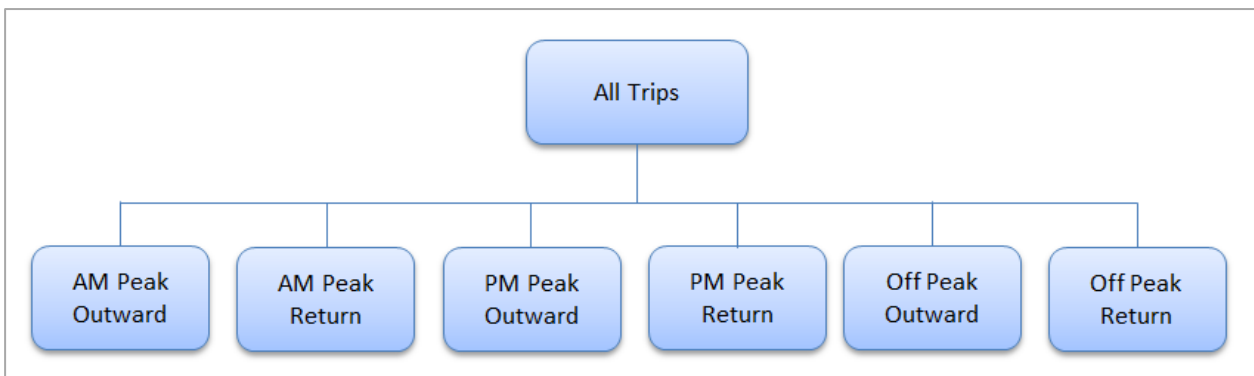
Figure 2: Allocation of Trips to Period / Direction Pairs

2.3 The Concept of Outward and Return Trips

The Zenith Period Allocation Model is responsible for assigning all trips a *direction*, either 'Outward' or 'Return'. The meaning of each direction is related directly to the definition of production and attraction activities.

Strictly, the directions are defined as follows:

- Outward: Production Activity → Attraction Activity
- Return: Attraction Activity → Production Activity

For example, in the case of home based work (which includes both home to work, and work to home trips), we have:

- Outward: Home → Work
- Return: Work → Home

Home is the production activity; work is the attraction activity. Conceptually, the trip was produced at the home, and attracted to the place of work.

For all trips involving the home (either as the origin or destination), the home is defined as the production activity. Therefore, all trips leaving the home are defined as Outward; all trips returning home are defined as Return.

For trips not involving the home (non-home based trips) which do involve work, work becomes the production activity.

Therefore, all such trips leaving work are defined "Outward"; all such trips returning to work are defined "Return".

For example, in the case of work based shopping (which includes work to shopping, and shopping to work trips), we have:

- Outward: Work → Shopping
- Return: Shopping → Work

For trips which don't involve the home or work which do involve shopping, shopping becomes the production activity.

Given the name of a trip purpose, one can easily infer the production and attraction activities by recalling the convention by which trip purposes are named.

Trip Purpose Naming Convention:

    Production Activity - **Based** - Attraction Activity

The concept of outward and return travel is fundamental to the achievement of the correct balance between peak direction and counter peak direction travel flows in each period.

For example, in the morning peak, a large proportion of Home Based Work trips are made in the Outward direction (home to work), while in the evening peak, the directionality tends to be reversed.

2.4 Functional Form of the Period Allocation Model

Standard Zenith Model Approach

The Zenith model uses fixed proportions to allocate total demand (all trips) to the various period / direction combinations. For example, the South East Queensland model uses the following factors for home based work (white collar):

- AM Peak / Outward: 0.2806
- Off Peak / Outward: 0.2055
- PM Peak / Outward: 0.0139
- AM Peak / Return: 0.0028
- Off Peak / Return: 0.2213
- PM Peak / Return: 0.2759

The proportions sum to 1, with 0.5 in the outward direction and 0.5 in the return. The most dominant period / direction combinations are AM Peak Outward (home to work in the morning peak), and PM Peak Return (work to home in the evening peak). This pattern is intuitive, and leads to formation of a "peak direction".

Each trip purpose has its own temporal characteristics, and its own set of period allocation factors. In some cases, period allocation factors are also defined spatially; especially travel to the CBD which often exhibits unique temporal characteristics.

Victorian and ACT Model Approach

The Zenith Models of Victoria and the ACT employ a more sophisticated approach to period allocation.

This approach involves linking together outward and return journeys into a limited form of tour. Rather than independently modelling outward and return journeys, the Victorian and ACT models consider outward and return journeys jointly.

To facilitate this approach, period factors are defined for each outward and return period combination. For example, Table 1 lists the factors used for home based (white collar) to the CBD. The rows in the table correspond to Outward periods, while the columns correspond to the Return. Of all two-way journeys, over 53% involve travelling to work in the AM Peak and returning home in the PM Peak.

HWW CBD Core	AM Peak	Inter Peak	PM Peak	Off Peak	Total
AM Peak	0.00	0.03	0.51	0.19	0.73
Inter Peak	0.00	0.02	0.10	0.10	0.22
PM Peak	0.00	0.00	0.00	0.00	0.00
Off Peak	0.00	0.02	0.02	0.01	0.05
Total	0.00	0.07	0.63	0.30	1.00

Table 1: Period Allocation Factors - Victorian Model

2.5 Data Sources and Parameter Estimation

The parameters of the Period Allocation Model are estimated using Household Travel Surveys.

Surveyed trips are grouped by trip purpose, and allocated to periods. If a trip spans multiple periods (e.g. 6:30am to 7:30am) then the trip is allocated proportionally to each period, in proportion to the amount of time spent travelling during each period.

Spatial variations in the period factors are explored, and in some cases lead to parameters that vary according to the origin / destination of the journey.

2.6 Model Limitations

This section outlines the key limitations of the Period Allocation Model:

Inability to Predict Changes in Departure Time Choice in Response to Changes in Cost

The Zenith Period Allocation Model assigns fixed proportions of demand to each period / direction for each trip purpose / origin / destination. As such, the model cannot currently be used to predict how the demands in each period might respond to changes in travel cost (e.g. peak spreading in response to increased traffic congestion), or pricing policies (e.g. time-differentiated road user charging).

Periods are not Perfectly Homogeneous

The periods used in the Zenith model are not entirely homogeneous. For example, the off peak period (6pm – 7am) includes the shoulder of each peak, as well as the true off peak where demands are very low.

The inter-peak includes the shoulders of each peak, the school peak (3-4pm), as well as the middle of the day (e.g. lunch time).

Further division of periods to achieve a greater level of homogeneity would be desirable, but would also come at a cost: increased model run times, and larger data storage requirements.