Zenith Transport Model

Technical Note 8
Demand Averaging

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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 Technical Note details the Demand Averaging process implemented within Zenith. The scope of this document does not extend to include region specific parameters (i.e. the weights used), or any validation of the process for specific regions or time horizons. These issues are to be dealt with in model specific Technical Notes relating to model convergence.

2 Demand Averaging

2.1 Background

The Zenith four-step model is iterative, with each iteration typically referred to as a "cycle" (mostly to avoid confusion with "iterations" of the traffic and transit assignment models).

At the end of each cycle, travel costs are output from the traffic and transit assignment models. These costs are fed back to the destination and mode choice models at the beginning of the next model cycle. This process is illustrated in Figure 1 below, with the feedback of travel costs marked as a dashed line.

The model is iterated until an acceptable level of convergence is achieved, where convergence can be measured in terms of:

- Similarity of travel costs between successive model cycles
- Similarity of travel patterns between successive model cycles
- Similarity of traffic, transit and pedestrian loads between successive model cycles

The aim of Demand Averaging is to ensure that the model reaches an acceptable level of convergence, and to minimise the number of iterations required.

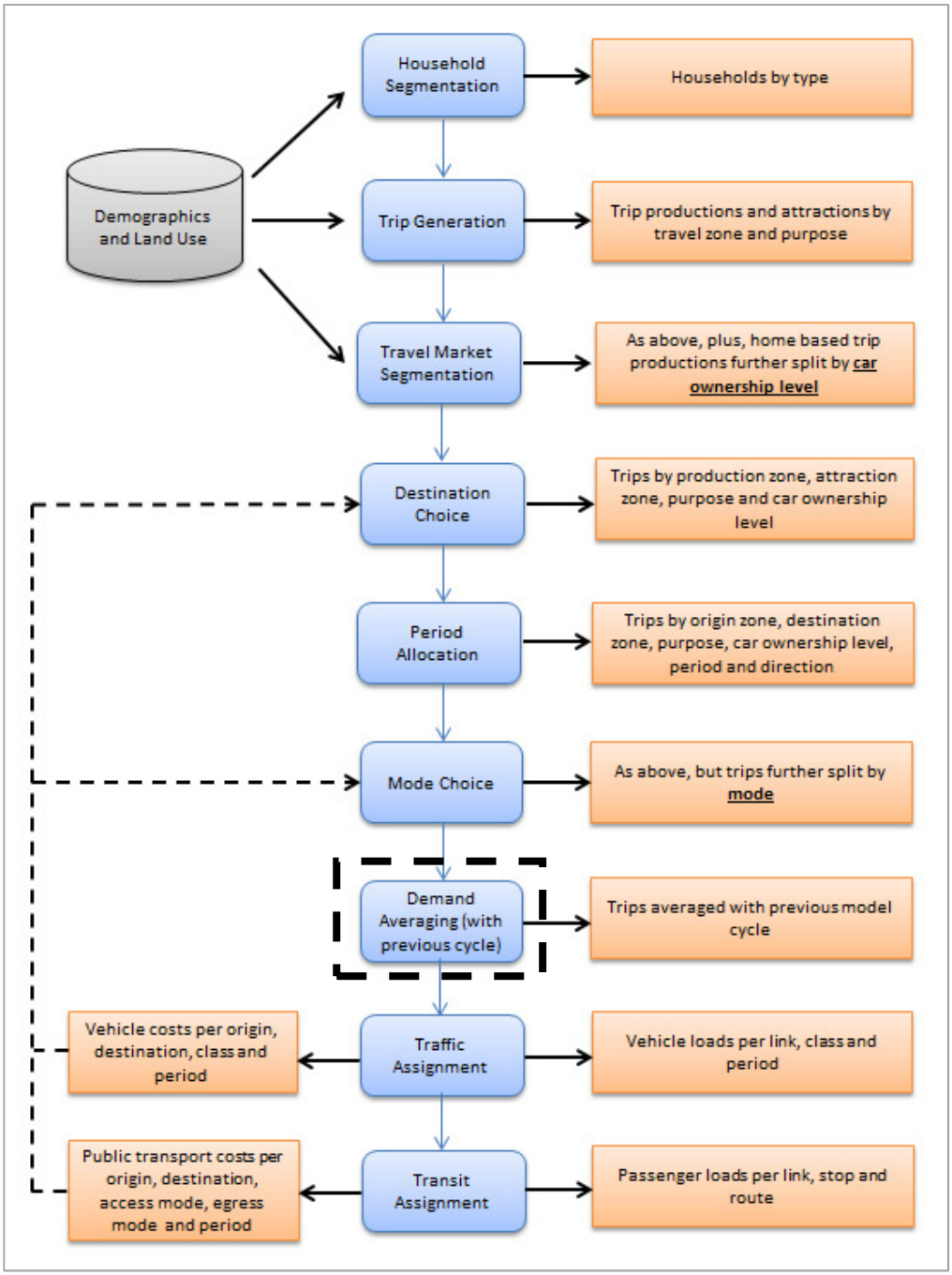

Figure 1 - Standard Zenith Model Run Process

2.2 Methodology

2.2.1 General Approaches

The most common approach to reducing the number of model cycles needed to reach model convergence is to introduce some form of "averaging" process, essentially "dampening" the fluctuations in travel cost between successive model cycles.

Three common approaches are:

- Averaging of travel costs between successive model cycles,
- Averaging of traffic and transit assignment loads between model cycles, prior to calculating travel costs,
- Averaging of travel demands between successive model cycles.

The last of these three approaches has been implemented in Zenith.

2.2.2 Demand Averaging

The Demand Averaging process occurs post-mode choice, and pre-assignment, as shown earlier in Figure 1 above.

At the conclusion of the Mode Choice model, each trip has been assigned a travel market segment (purpose, car ownership level, etc.), a production zone, an attraction zone, a period, a direction, and a primary mode (car, walk, cycle, public transport by access mode). The trips are ready for assignment to the network, through the Traffic and Transit Assignment models.

Demand Averaging involves the averaging of these trips with the trips that were assigned in the previous model cycle, prior to assignment. Specifically, this involves averaging the number of trips per production zone, attraction zone, period, direction and mode. In the first model cycle, there is no previous cycle with which to average, so no averaging takes place.

The process by which demands are averaged across model cycles is illustrated in Figure 2 below.

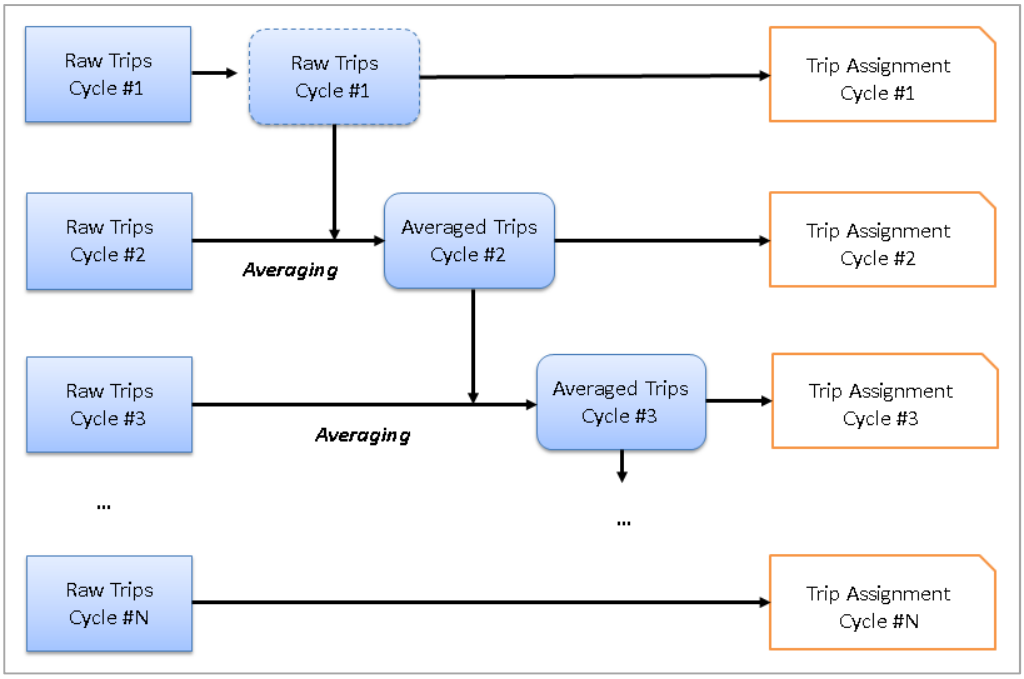

Figure 2 - The Demand Averaging Process

In the first model cycle (the first row), the model's raw trips are assigned to the network without any averaging.

In the second model cycle (the second row), the model's raw trips are averaged with the raw trips output from the first model cycle.

In the third model cycle (the third row), the model's raw trips are averaged with the averaged trips from the second model cycle.

This pattern is repeated until the final model cycle (notionally, cycle #N), when no averaging takes place. The motivation for not averaging on the final cycle is to ensure full consistency between costs and demands in the outputs that will be analysed by the model's users.

2.2.3 Weighting of Model Cycles

In the previous section the concept of demand averaging was introduced. The default approach within Zenith is to employ a 50-50 average at each averaging step, though this assumption can be varied by the user. Because the average from one model cycle is used as input to the average for the next model cycle, the averaged demands will become a weighted average of all prior model cycles.

For example, the weighting of model cycles within a 5 cycle model run is illustrated in Table 1 below, assuming 50-50 blends at each step.

In cycle #2, the averaged trips are a 50-50 blend of the raw trips output from cycles #1 and #2.

In cycle #3, the averaged trips are a 25-25-50 blend of the raw trips output from cycles #1,#2 and #3 respectively.

In cycle #4, the averaged trips are a 12.5-12.5-25-50 blend of the raw trips output from cycles #1,#2,#3, and #4 respectively.

In cycle #5, the final model cycle, no averaging takes place.

		Raw Trips				
		Cycle #1	**Cycle #2**	**Cycle #3**	**Cycle #4**	**Cycle #5**
Averaged Trips	**Cycle #1**	100%				
	Cycle #2	50%	50%			
	Cycle #3	25%	25%	50%		
	Cycle #4	12.5%	12.5%	25%	50%	
	Cycle #5					100%

Table 1 - Weighting of each Cycle in the Averaged Trips at each Iteration

3 Sources of Further Information

This technical note has described the objectives and methodology underpinning the Demand Averaging process implemented in Zenith. It has not listed the weights or number of model cycles used in specific regions or projects, or any validation of the process for specific regions or time horizons. These are documented in model specific technical notes relating to model convergence. For access to these technical notes, visit:

http://zenith.veitchlister.com.au/documents

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