Analysis Procedure Manual

Change Sheet – January 2016

APM Version 2

Acknowledgements

Added to Oregon Department of Transportation Group:

Richard Arnold, P.E.
Rebecca Knudson
Tara Weidner, P.E.

Chapter 7

Added:

Chapter 7.

Analysis Procedure Manual

Change Sheet – February 2016

APM Version 2

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Added to DSK Associates:

John Bosket, P.E.
Ben Chaney, EIT
Tegan Enloe, P.E.

Added:

IvS Analytics Ida Van Schalkwyk

Chapter 4

Changed:

Various Chapter 4 changes.

Chapter 14, Sub-section 14.5.7

Added:

Sub-section 14.5.7 Shared-use Paths

Technical Tools webpage

Added to Safety Analysis Tools:

- Excess Proportion of Specific Crash Types Calculator - This Excel spreadsheet is an ODOT adaptation of the Highway Safety Manual Part B Excess Proportion of Specific Crash Types network screening methodology. The user inputs ODOT crash data within a study area. The tool performs statistical analysis to calculate a probability of specific crash types exceeding a threshold proportion. Then it identifies intersections with an excess proportion of specific crash types. For information on how to use and interpret this spreadsheet, see the instructions packaged with the spreadsheet and Chapter 4 of Analysis Procedures Manual (APM) Version 2.

Added to Multimodal Analysis Tools:

- Shared Path Calculator - This Excel spreadsheet implements the Highway Capacity Manual 2010 Chapter 23 method shared path methodology for pedestrian and bicyclists. For more information on the use and inputs for the tool please see Chapter 14 of the Analysis Procedures Manual (APM) Version 2.

Analysis Procedure Manual

Change Sheet – March 2016

APM Version 2

Chapter 14, Section 14.5

Added:

New Section 14.5

Chapter 14, Section 14.6

Changed:

Former Section 14.5 renumbered to 14.6.

Chapter 14, Section 14.7

Changed:

Former Section 14.6 renumbered to 14.7.

Analysis Procedure Manual

Change Sheet – May 2016

APM Version 1

Chapter 8, section 8.4

Section replaced with:

8.4 Vissim - Overview

Vissim is a simulation program that can model multi-modal traffic flows including cars, trucks, buses, heavy rail and light rail transit (LRT) as well as model traffic management systems (ramp meters, toll roads, and special lanes) and transit priority systems. Vissim can also model trip assignment, over fixed routes or dynamically, where vehicles change routes in response to specified events and can animate traffic movements in 3-D. Vissim is a program that can stand alone, but is data intensive to create files for use on its own. Alternatively, the files can be created in Visum (a travel demand program) that can then import the files into Vissim for analysis. See APM version 2 Appendix 8B for guidance on creating networks using PTV Vision Suite software (Visum, Vissim, and Vistro). Because most ODOT region offices do not perform travel demand modeling, it is important to note issues both with and without Visum.

Other advantages of Vissim include the rail-roadway interface, which requires Vissim Level 3 or 4 in order to model the effect of rail crossing blockages on queues and roadway operations. Another advantage is that Vissim has the capability of "dynamic traffic assignment" (DTA), which will reroute a vehicle on the network in case of a crossing blockage or an overcapacity situation. Note that this strength of the software comes at the price of larger study areas to allow for correct dynamic assignment and to address effects occurring potentially outside of the focus of the study area. DTA will likely require more data, measures and resources to properly calibrate (see APM version 2 Chapter 8 for more information).

APM version 2 Addendum 15A is a link to the ODOT Vissim Protocol which governs documentation and creation of all Vissim models created for ODOT plans and projects.

Vissim has the capability of performing analysis directly on Visum traffic volume assignments and includes a post-processing function. The results of this type of analysis may be acceptable for certain applications, such as sketch planning and alternative screening. However, for most types of analysis, DHVs are required. The function in Vissim does not create DHVs, therefore the post-processing procedures outlined in APM version 2 Chapter 6 are still necessary.

Most ODOT region offices do not currently own the Vissim software (outside of Region 1). The ODOT Synchro defaults should be implemented in the Vissim model to the extent possible. Most region offices outside of Region 1 are unlikely to have the knowledge base to use Visum.

APM Version 2

Chapter 8, Sections 8.1 – 8.2.2

Sections replaced with:

8.1 Purpose

This APM chapter provides fundamental guidance and overview of an array of methods related to mesoscopic modeling. Mesoscopic methods are rapidly changing based on availability of new tools and data sources, such as the move towards activity based travel demand models. This chapter focuses on methods that have previously been applied in projects involving ODOT and is not intended to be comprehensive for all mesoscopic methods and tools. Other methods not documented in this chapter may be applied, if appropriate, through consultation with TPAU staff.

The purpose of this chapter is to provide an overview of methods and tools available to apply mesoscopic analysis. The information provided in this chapter is intended to provide the user with the information required to understand the general approach for scoping project methodology and understanding the differences between various methods along with limitations and advantages of using each method. For more details on many of the methods in this chapter also refer to NCHRP Report 765.

8.1.1 Overview of Chapter Sections

This chapter covers a broad array of topics related to mesoscopic analysis. Topics included cover:

- Scoping – How to identify approach, tools, and effort based on the analysis needs.
- Subarea Analysis – How to develop subarea models that increase the detail from an existing model.
    - Focusing – General procedures for adding detail and creating a focus area model within a regional model.
    - Windowing – General procedures for selecting an area to "cut" or "window" out into a separate model that can then have additional detail.
- Dynamic Traffic Assignment (DTA) – Analysis considerations and triggers that may lead to analysis that considers traffic routes and travel times that vary by time of day.
- Peak Spreading – General concepts and analysis considerations to identify how congestion spreads from peak periods to larger intervals and the impact on vehicle demand during shoulder periods.

8.1.2 Key Definitions

Section 8.1.4 includes references to other chapters of the APM that provide material that may be related to mesoscopic methods covered in this chapter.

Having a common understanding of the terms in this chapter is necessary for proper implementation of methods and tools. Definitions for terms included in this chapter are included in the Glossary. Selected terms that are needed for fundamental content are shown below.

- **Macroscopic Model**– Aggregate models that have a high-level view of the transportation system and do not include many transportation network details. Macroscopic travel demand models are generally large (potentially regional) in size and focus on general vehicle flows and route choice from one area to another. Streets may be approximated by the average number of lanes, a free-

flow speed, and approximate vehicle capacity. Vehicle trips are routed through the network based on algorithms that select paths that minimize the travel time.

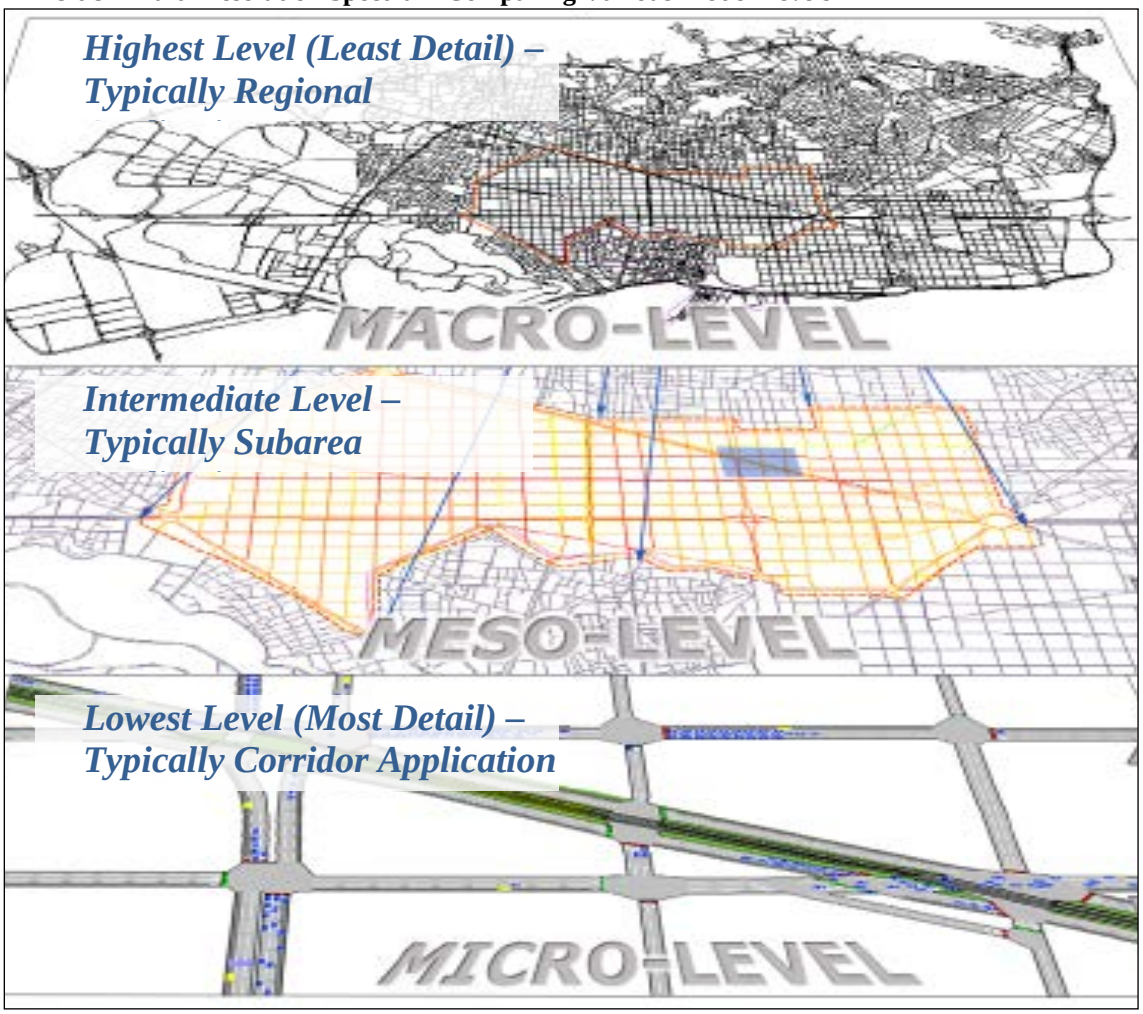
- **Mesoscopic Model** – A hybrid model that includes combinations or approximations of elements from both macroscopic and microscopic models. Mesoscopic models may include a routable network similar to a macroscopic model (with a supplementary origin-destination matrix), while also incorporating more detailed operational elements of the transportation network to better estimate travel time based on traffic operations similar to a microscopic model. Elements from either the macroscopic or microscopic models may be generalized or simplified.

- **Microscopic Model** – Detailed models that are at a fine scale and typically include all streets and components of the transportation system that impact travel. Such elements can include intersection control and striping, pedestrian crossings, transit stops, and even the inclusion of traffic calming measures. Microscopic models typically refer to simulation models that include randomized characteristics and behaviors of an array of drivers and vehicles as they traverse a network. The performance of these models is typically averaged over several "runs" to account for the randomized driver and vehicle characteristics. Unlike macroscopic models, traffic demand values are generally inputs and typically do not result from path choice within the model, therefore, there may not be a predetermined throughput. As a result, assigned traffic volumes at specific locations such as midblock or a turn movement may not match the input demand due to constraints on the network metering flow. For example, queues will build in a microscopic model and only vehicles that can make it through a bottleneck in a given time period will be observed.

- **Multi-Resolution** – The combined framework of an integrated series of models, each built or scaled for the appropriate level of "resolution" and detail given the context for project application and need. The individual model components (resolutions) each can be integrated for a particular project/analysis that benefits from the data analysis and output of the individual tool and level. General levels, or "resolutions", that may be used to describe models or application that fit a general context include microscopic, mesoscopic, and macroscopic models as shown in Exhibit 8-1.

  Appendix 8B provides a user guide for the PTV Vision Suite software which is an example of a multi-resolution tool. The guide is provided to help infrequent users get a quick start in building, importing and exporting networks for analysis.

Exhibit 8-1Multi-Resolution Spectrum Comparing Various Model Levels



8.1.3 Introduction to Mesoscopic Analysis

Transportation analysis methods have traditionally focused on two levels of detail, macroscopic and microscopic. ***Macroscopic*** analysis is concerned with system-wide travel movements; how much travel, of what types, when, how, and by what modes and major routes. Urban, regional, and statewide travel demand models are the primary tools used to do this level of analysis. These tools facilitate the evaluation of the effects of demographics, economics, land use patterns, transportation network configurations, and prices on travel patterns. These models assess how many trips are moving between areas (zones) and along which routes (links). Because they are not built for focused urban area studies they do not typically account for the influences on delay from turning lanes and signal or stop sign controls at intersections. Likewise, macroscopic models provide no information on the location and duration of queuing. Furthermore, they are not calibrated to the level of local streets and points of access to the network (e.g. parking locations).

Microscopic analysis is concerned with the operational performance of transportation facilities; traffic flow rates, queuing, speed, and delay. This level of analysis uses micro-simulation models and highway capacity manual methods primarily. These tools facilitate the evaluation of the effects of localized land uses, roadway geometry, and traffic controls on traffic flow characteristics. However, most microsimulation models rely upon fixed post-processed traffic volume inputs from travel demand models to evaluate future year scenarios and are, therefore, only as good as the volumes put into them. Furthermore, project application of microsimulation models typically requires many hours devoted to model development due to the level of detail incorporated in the models. While these models provide a good estimation of traffic operations, they are often not practical to implement as a tool to evaluate or

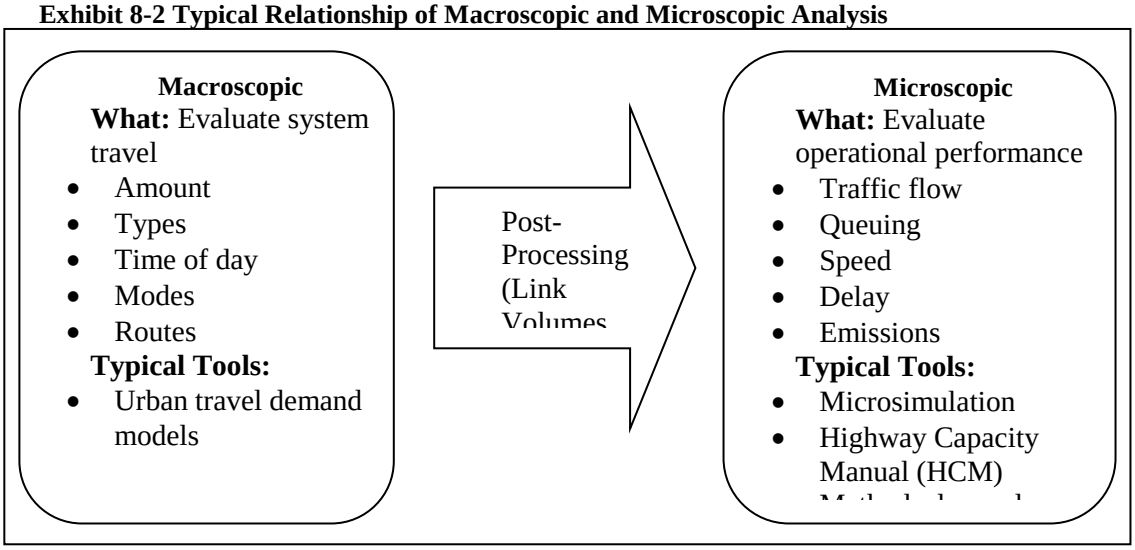
screen a large number of alternatives or a large analysis area.

One major difference between macroscopic and microscopic analysis is that macroscopic models use land use data as the primary input that dictates demand for travel, whereas microscopic use traffic volumes or vehicle trips as the primary input that dictates the demand for travel. The impacts of land use on travel demand are external to microscopic models and assumed to be already accounted for in the microscopic model's traffic volume inputs. Likewise travel costs (e.g. fuel prices, the traveler's value of time, transit fares) are direct inputs to macroscopic models dictating travel mode and route choices. These travel costs and decisions are external to microscopic models, and assumed to be already accounted for in the microscopic model's traffic inputs.

These two levels of analysis (macroscopic and microscopic) are loosely coupled through the transmittal of link and turn volume data and the use of travel demand model post-processing methods. The flow of the data is from macroscopic to microscopic, and there is typically no feedback from microscopic to macroscopic (e.g. queuing calculations do not affect system travel calculations).

The following diagram illustrates these two levels of analysis and their connection.

Exhibit 8-2 Typical Relationship of Macroscopic and Microscopic Analysis



Increasing attention is being given to the combination between the macroscopic and microscopic modeling levels, often referred to as "***mesoscopic***." While the term "mesoscopic" can have various meanings for users in different fields and even to multiple users within the field of transportation, it generally is used to denote a hybrid of microscopic and macroscopic features. Exhibit 8-3 demonstrates the relationship between these three general fields.

Exhibit 8-3 Mesoscopic Overlap between (and Potentially Combining) Macroscopic and Microscopic Modeling Process

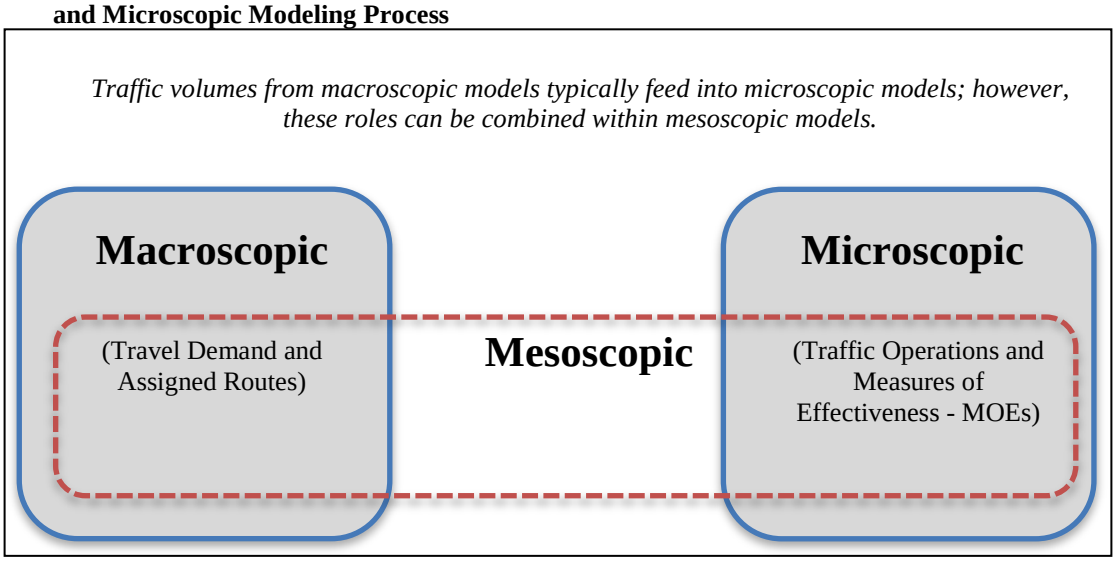


Exhibit 8-4 lists potential examples that summarize key comparisons among typical microscopic, mesoscopic, and microscopic models. These examples are provided for demonstrative purposes and actual characteristics of these models can differ.

Exhibit 8-4 Summary of Typical Differences among Microscopic, Mesoscopic, and Macroscopic Models

	Detail Present		
Model Element	**Macroscopic**	**Mesoscopic (Potential hybrid)**	**Microscopic**
Network Scale (Size)	Region-wide	Varies. Potentially region-wide, but may be smaller, depending on level of network detail and mesoscopic software	Typically a single corridor or small study area
Network Scale (Detail)	Regionally significant routes (generally collector and higher)	Varies. May include all public streets, but could include less depending on network size	All streets and major driveways
Intersection Detail	None (typically a simple node junction of streets without time-penalty and without geometric or control characteristics)	Generally includes types of attributes needed for HCM level analysis (intersection control, lane geometry, basic signal timing, etc.)	Full lane geometry and widths, turn bay lengths, traffic control and striping, signal timing detail for individual phases (if applicable)
Travel Time	Link-based travel times generally rely on volume-delay functions (vdf). Intersection delay is generally ignored or simplified.	Can have a combination of link and intersection travel time, though intersection delay may be less robust than microscopic models	Travel time is based on vehicle interaction and includes acceleration, deceleration, stopped delay, and other associated factors

"Outputs" - Measures of Effectiveness (MOE) / Performance Measures	Vehicle hours of delay, corridor travel time, average distance traveled by users on a link	Provides general MOEs possible in both macro and micro models, without full detail (e.g. queue lengths and impacts) of micro models.	Intersection turn delay, corridor travel time, 95th percentile vehicle queue length, etc.
Routes / Assignment (Is route diversion possible?)	Yes (routes vary based on relative "cost" of all potential routes, typically travel times)	Yes	No (traffic volumes and route paths are typically a fixed input and route options/ diversion are not present)

Needs

Mesoscopic analysis capabilities can help meet emerging analysis needs and overcome limitations of the traditional process and tools (macroscopic forecasts fed into microscopic models). In particular, the following needs can be addressed:

1. Operational Impacts
    - Restricted funding and less interest in making major changes in the roadway system are shifting the focus of planning to system management and leveraging the effects of changes in operations and many small system improvements. In addition, there is increasing interest in modeling operational improvements that improve reliability and reduce incident-related congestion. Macroscopic models are typically not applied in a manner that is precise enough to model the effects of traffic operations or minor improvements. Microscopic models can analyze these effects, but cannot do so at a large-scale systems level. Moreover, microscopic models require a very large amount of data and are impractical to develop for an entire urban road system.
    - The focus on operational improvements and smaller system changes requires the use of more precise performance measures in order to distinguish the relative benefits of alternative choices. Macroscopic models use travel time and speed measures having limited precision (e.g. do not capture the vehicular delays upstream of system bottlenecks). These measures are necessary in order to predict travel patterns, but precision has been limited for reasons of computational tractability and because precision may not have been important for the regional decisions being made. Microscopic models can produce these measures, but only for a relatively small portion of the system.
    - The operational impacts of interactions with other modes (such as bus stops or rail crossings) can impact travel time along a route and thus route choice. For example, the impacts that transit vehicles have on auto travel times are ignored in most macroscopic models (e.g. additional traffic congestion caused by buses on mixed use roadways and vehicular delays occurring at rail crossings). These impacts can be explicitly modeled and evaluated using microscopic models.
2. Congestion Impacts
    - As traffic congestion severity, extent, and duration grow, the travel time and speeds estimated by macroscopic models become less able to reflect actual travel conditions. Macroscopic models have a limited ability to account for congestion on adjacent (downstream) links, as well as within (adjacent lanes) a given roadway segment. Consequently, macroscopic models are less able to account for the effect of traffic congestion on travel patterns. This has been a significant consideration in the Portland metropolitan area for some time, and is starting to become an issue in other areas of the state as well.

    - The effects of severe congestion may not be reliably accounted for by microscopic models. How are the system constrained traffic volume and trip inputs for microscopic models developed for future year scenarios (as the severity, extent, and duration of traffic congestion grows) without the help of macroscopic travel models?
3. Sensitivity/Risk Testing/Alternatives Analysis
    - There is increasing interest in assessing the risks associated with uncertain futures (e.g. amount and distribution of land uses, fuel and other travel costs, government policies, regional economic and funding issues). The assessment of uncertainty and risk requires a more comprehensive analysis than is presently done. In the past, assumptions were made about many factors (such as land use, transportation network changes, etc.) in order to limit the number of alternatives needing to be analyzed. This has been necessary because of the amount of work required to develop models and process outputs from macroscopic models to be input into microscopic models and time required to adequately develop microscopic models.

Mesoscopic modeling has the potential for meeting these emerging needs and overcoming existing limitations by leveraging the strengths of both macroscopic and microscopic modeling:

- Operational performance can be calculated with more detailed metrics than is currently done by macroscopic models in order to account for the effects of smaller changes to the system and to distinguish smaller differences between alternative improvements. The calculations in mesoscopic models are less precise than those of microscopic models; this reduces the data needs and model run-times so that entire regional transportation systems or large portions of transportation systems can be modeled.
- Since mesoscopic models can make more detailed calculations of performance, in some cases they may be a substitute for microscopic models for the purposes of uncertainty and risk analysis. For larger systems with severe congestion issues, a mesoscopic model will allow for realistic results to be generated at a lower detail level but still meet the needs of the project development process. The calculation of the performance measures by a mesoscopic model would reduce the need/use of microscopic models for alternatives testing and greatly increase the number of scenarios that could be analyzed within a given amount of time and resources. Microscopic models would continue to be used for more detailed analysis of a limited number of scenarios.
- Mesoscopic models can provide a mechanism for feeding back better estimates of travel times reflecting very congested conditions to macroscopic modeling processes for forecasting travel demand for successive iterations in the macroscopic models. This might be done by incorporating the mesoscopic model into the macroscopic model, or by using the mesoscopic model as a post-processor of the macroscopic model.

When to Consider Mesoscopic Analysis

Many considerations exist that could lend mesoscopic procedures being applied for an analysis. Some of these considerations for mesoscopic application could include:

- Do a large number of system network alternatives need to be analyzed or screened at a system level? Is it not feasible/cost-effective (or appropriate) to model all alternatives in microscopic analysis? Does macroscopic analysis not provide adequate detail for providing relative comparisons among alternatives?
- Do network alternatives include operational impacts or improvements that may not be captured with a macroscopic model?
- Do network alternatives have the potential to impact system circulation and routing due to the outcome of the resulting traffic operations and flow?
- Does a level of congestion exist that may not be captured with a macroscopic model?

Any of the items listed above may be an indication that mesoscopic analysis would be beneficial for project application. While defined triggers do not exist, generally a mesoscopic approach will provide additional benefit in cases where both macroscopic traits (such as route choice) and microscopic traits (such as traffic operations, performance measures on duration and severity of congestion and queuing)

are desired in a hybrid environment.

8.1.4 Related APM Chapters

Several other chapters provide related guidance. These chapters and the relation each has to this chapter are listed here.

- Version 2 Chapter 2: Scoping Projects – Guidance on scoping transportation analysis work. Includes comparisons of analysis tools and guidance on tool selection.
- Version 2 Chapter 3: Transportation System Inventory – Includes information about data collection that may be needed for application of the methods covered in this chapter.
- Version 2 Chapter 5: Developing Existing Year Volumes – Includes information about volume development that may be needed to estimate demand for some of the tools and methods covered in this chapter.
- Version 2 Chapter 6: Future Year Forecasting – Provides information about developing future forecasts and includes subarea assignment methods. The chapter also describes multiple forecasting methods, including use of travel demand models.
- Version 1 Chapter 8: Traffic Simulation Models – Procedures for microsimulation model development and calibration.
- Version 1 Chapter 10: Analyzing Alternatives – Includes information about developing sets of alternatives that may be analyzed or screened using the tools and methods covered in this chapter.

8.2 Subarea Analysis

This section provides an overview of types of subarea analysis and general considerations for application. Two types of subarea analysis, focusing and windowing, are covered in greater detail in following sub-sections.

8.2.1 General Considerations

The analyst has a number of tools and methods available for application. A critical component of any project is first selecting an appropriate tool and then determining how to best apply that tool. In many cases, the best tool available may not be adequately refined for the intended application. In the case of a regional travel demand model, the model may be constructed and calibrated to a regional scale. However, with the appropriate additional refinement, the model (tool) may be applicable to additional uses. Creating a subarea model is a common example of applying model refinement for more rigorous use beyond the original scale of the model.

This subsection describes general subarea refinement and considerations. A ***subarea*** is a specified area that is identified for refined analysis. This may require a model or tool that includes additional detail beyond what is used for areas outside the subarea in order to adequately capture the desired level of analysis. The subarea may be similar to a "study area" identified through the analysis as the general area included in the analysis, but often these areas differ based on the degree of analysis needs and tools present.[1]

Once an analyst is aware of pre-existing models, the decision about model applicability and potential to use the model for another purpose must be made. While this decision process should be coordinated with Transportation Planning Analysis Unit (TPAU) and documented, the following considerations may indicate the potential for applying subarea analysis:

Is the "base model" (agency or regional model) appropriate for further project use?

- Does the model boundary fully include the study area?
- Does the model consider the appropriate time period (hour of day, season, etc.)?

[1] Considerations for identifying subarea boundaries are presented later in this section.

- If land use changes are being investigated, are the scale and type of uses appropriate for the model? Smaller magnitude areas, such as some traffic impact analysis (TIA) for the development review process, may not require land use adjustments in the model if it is being used to forecast background growth. However, larger magnitudes may require land use adjustments or even be beyond the scope of the model. Additional documentation on this matter is provided separately.[2]
- Does the model boundary include key locations outside of the study area that may influence operations within the study area (downstream interchanges, over capacity intersections, etc.)?

Is subarea refinement needed for model application?

- Does the model include all transportation facilities relevant to the study? This may include study intersections as well as parallel facilities or alternate routes, which may be needed for gauging traffic diversion.
- Is the zone structure detailed enough for the analysis and are centroid connectors placed in a way that will not impact the outcome of the results?
- Is the model sensitive enough to test the range of alternatives under consideration, such as intersection control and geometry or signal timing changes?
- Is a specific zone or unique land use not adequately captured due to the regional scale of the model?
- Is the zone and centroid connector structure detailed enough to perform Origin-Destination (O-D) matrix estimation procedures if needed?
- What will be the ultimate use of the model data? Do HCM procedures need to be performed on study intersections? Will the model be exported to microsimulation?
- Do other modes of travel need to be considered that are not included in the regional model? For instance, do a significant amount of trucks or heavy vehicles need to analyzed separately and/or account for restricted routes? Are there other modal network elements?
- Is a more realistic assignment needed due to extensive peak period congestion?

The considerations above are intended to serve as a general guide for determining model application potential. However, given project context, other considerations may exist and coordination with TPAU is needed. The following sections explore these general considerations in more detail.

8.2.2 Overview of Focusing and Windowing

Focusing and windowing are two general types of subarea models that are commonly applied. These approaches can be applied for both macroscopic and mesoscopic analysis models. While each of the two methods shares similarities, there are also distinct differences.

Focusing is the practice of adding additional refinement and detail to a model within the structure of that model. The additional resolution may be added to the supply (transportation network) or the demand (zone structure or loading). In either case, the full function of the model is maintained.

Windowing involves cutting out a portion or component of a model. Often, this will include a "window" of the transportation network in the subarea that then creates cordon (external) areas at the edge of the subarea. Windowing, like focusing, is applied to allow additional refinement or modification. However, because windowed models are separate from the original model, they are not held to the same requirements for consistency[3] and integration with the full model. This allows for testing changes from the original model (such as travel demand intensity or trip assignment technique). Results of the windowed model are specific to the window itself and are not necessarily relevant to the original model. In some cases, the entire model area may be windowed in order to test scenarios (or framework) that differs from the base regional model.

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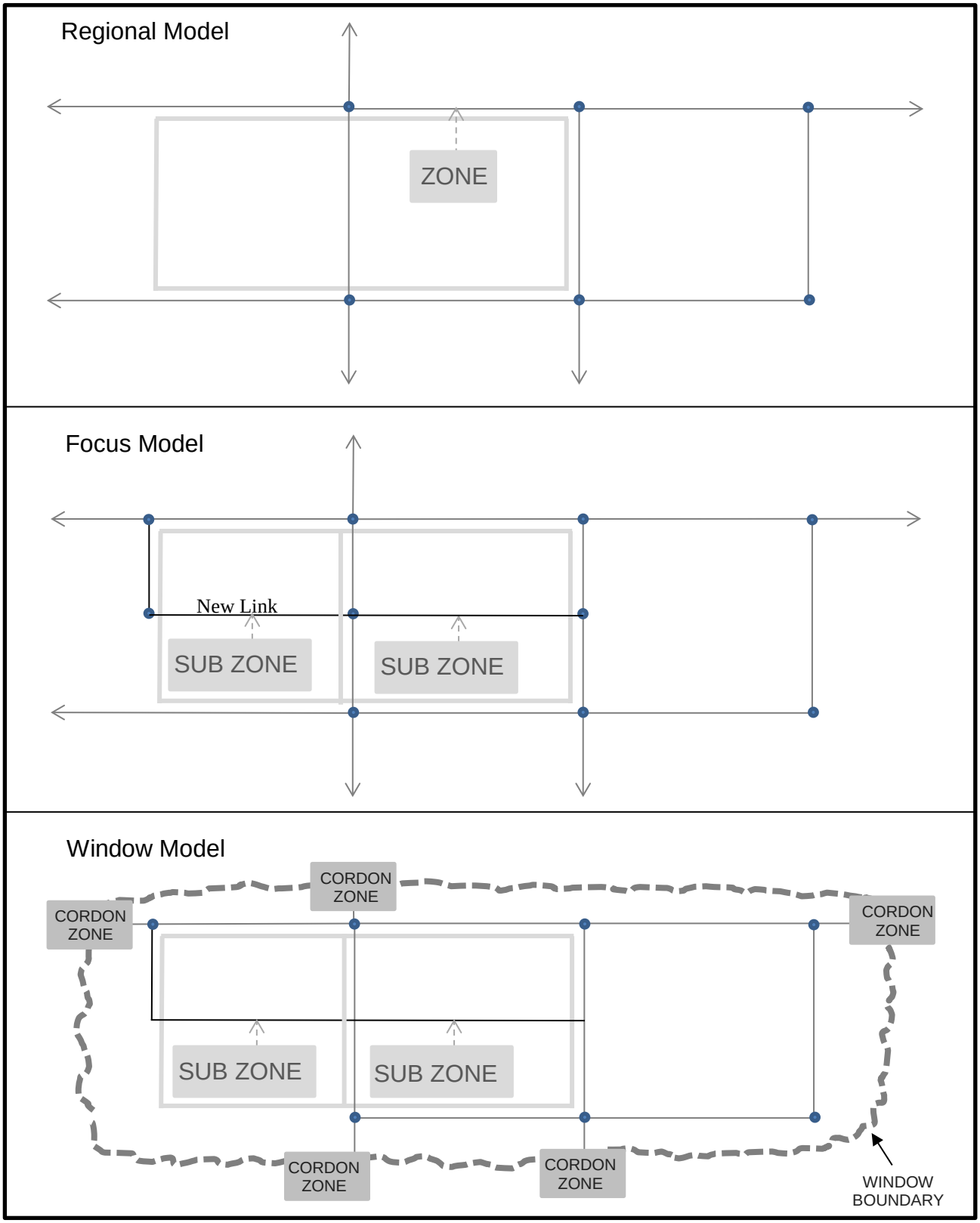
[2] Modeling Procedures Manual for Land Use Changes, TPAU, February 2012.

[3] Coordination with TPAU is necessary to determine if the level of adjustments are appropriate and reasonable for the windowed area model.

Refer to Appendix 8B Section 1 for guidance on windowing using PTV Visum software. If the model is in the Emme platform, see Section 4.1 for guidance on converting the model network to Visum.

Exhibit 8-5 demonstrates the general differences in network refinement that a focus and window subarea model would add to a base model network.

Exhibit 8-5 Comparison of Base/Regional, Focused, and Windowed Models



Overall APM Version 2

Added:

Miscellaneous/minor corrections.

Technical Tools Webpage

Deleted:

- **SIGCAP 2 (Not compatible with Windows 7)**
  - SIGCAP2 is a signalized intersection capacity analysis tool for planning purposes. It calculates intersection level-of-service (LOS) using the volume-to-capacity (v/c) ratio. SIGCAP and SIGCAP2 are based on the older 1985 Highway Capacity Manual (HCM) methodology, therefore, should only be used for ballpark estimations. Only software based on the current HCM shall be used for traffic analyses.
  - SIGCAP2 Users Manual

Deleted:

- **UNSIG (Not compatible with Windows 7)**
  UNSIG - UNSIGnalized Intersection Analysis Program (Windows self-extracting zip file) This is the latest version of UNSIG10 (18 October 1988). It is an un-signalized intersection capacity analysis program designed to essentially duplicate the procedures from the Transportation Research Board 1985 Highway Capacity Manual.

  UNSIG10 is based on the older 1985 Highway Capacity Manual (HCM) methodology, therefore, should only be used for ballpark estimations. Only software based on the current HCM shall be used for traffic analyses. UNSIG 10 User's Guide.

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Various minor corrections.

APM Version 2

Chapter 18

Added Chapter 18.

Overall APM Version 2

Various minor corrections.

Analysis Procedure Manual

Change Sheet – September 2016

APM Version 2

Chapter 14, Sections 14.5 and 14.6

Added: Section 14.6.5 Separated Bikeways and 14.6.6 Buffered BikeLanes.

Tools webpage

Added:

- Separated/Buffered Bikeways Calculator (XLSX): This tool performs analyses on the operation of separated bikeways and buffered bike lanes. For more information see Chapter 14 of the APM Version 2.