A REPORT ON THE USE OF TRAFFIC SIMULATION MODELS IN THE SAN DIEGO REGION

Prepared By:

Institute of Transportation Engineers
California Border Section
Highway Capacity Task Force

March 17, 2004

ACKNOWLEDGEMENTS

Institute of Transportation Engineers – California Border Section

Board Members
Ralph Leyva, P.E., President
Zoubir Ouadah, P.E., Vice President
Ahmed Aburahmah, P.E., PTOE, Treasurer
Edgar Perez, P.E., Secretary
Frank Yates, P.E., Past President

Contributing Authors
Erik Ruehr, P.E.
Sam Morrissey
Mike Calandra
Monique Chen
Ahmed Aburahmah, P.E., PTOE
David Wong-Toi, P.E.

Additional Highway Capacity Task Force Members
Andy Schlaefli, P.E.
Majed Al-Ghafry, P.E., PTOE
Edgar Perez, P.E.
Dan Benson, P.E.
Jim Lundquist
Ellison Alegre
Kim Sturmer
Maurice Eaton
Bill McFarlane
Patti Boekamp, P.E.
Larry Wherry, P.E.
Marc Mizuta, E.I.T.

Special Thanks to Members of the San Diego Traffic Engineers Council, Selected Members of ITE – District 6 Who Participated in the Surveys Summarized in This Paper, and Staff Members of ITE Headquarters Who Made Arrangements for a Web-Based Survey of ITE District 6

TABLE OF CONTENTS

1. INTRODUCTION

Recent advances in computer technology and traffic flow theory have led to the widespread creation and use of traffic simulation models by traffic engineers and transportation planners involved in the planning, operations, and design of transportation facilities. Prior to the development of traffic simulation models, studies to plan and improve roadway facilities were typically undertaken by computational methods that could estimate capacity, delay, level of service and other parameters for a given set of roadway conditions. Traffic simulation models are able to provide these measures of effectiveness, and also provide an added dimension to the ability to analyze roadway traffic conditions. Because simulation models track the movements of vehicles on an individual basis, they allow the analyst to test a wide range of roadway configurations and operational conditions that far exceed the limits of more conventional analysis tools.

In addition to their usefulness in analyzing a unique set of conditions, most traffic simulation models include highly sophisticated displays that allow visual demonstration of traffic operations on a computer screen. Traffic conditions that could previously be described only in words or numbers can now be simulated on a computer and displayed so that a visual real-time picture of traffic conditions can be seen. This has enhanced the ability of people both inside and outside the transportation profession to visualize the results of future actions. Simulation results can be displayed in public meetings, allowing decision-makers and the public a way to visualize traffic operations in ways that were not possible using conventional tools.

Although traffic simulation models offer important advantages as analysis tools, they have some limitations and disadvantages when compared to more traditional analysis tools. They are typically more costly to utilize than traditional computational methods. Because of their complexity, it is also more difficult to maintain consistent standards for the use of simulation models as compared to other traffic engineering analyses. In this discussion, the reference to “traditional” analysis tools refers to methodologies that use equations to estimate capacity and delay based on a given set of input parameters.

Because traffic simulation models have only come into widespread use in recent years, there are relatively few guidelines and standards to govern their use. While the transportation profession seems to be in agreement that traffic simulation models are highly useful tools, there are a variety of models available and a high potential for misuse and misinterpretation of results. In this environment, it is highly desirable that traffic engineers and transportation planners work together to share knowledge and educate each other on the potential advantages and pitfalls in the use of traffic simulation models. This paper was written by the Highway Capacity Task Force of the Institute of Transportation Engineers California Border Section with the purpose of allowing transportation professionals in the San Diego area to increase their knowledge of traffic simulation models. It provides general information on traffic simulation and specific information on their current use in the San Diego region and the western United States.

The remainder of this paper is divided into sections that describe different aspects of traffic simulation. This introduction concludes with a definition of simulation models and a brief description of the organization of the Highway Capacity Task Force. The following chapters contain information on nationwide research into traffic simulation, an overview on the use of traffic simulation models, specific information on the types of simulation models used in the San Diego area and beyond, and guidance on use of simulation models based on the experiences of task force members.

DEFINITION OF TRAFFIC SIMULATION MODELS

One of the difficulties in any discussion of traffic simulation is that simulation can mean different things depending on the point of view of the analyst. The Highway Capacity Manual defines a simulation model as "a computer program that uses mathematical models to conduct experiments with traffic events on a transportation facility or system over extended periods of time". Some discussions refer to macrosimulation (travel forecasting models) versus microsimulation (traffic operations models).

For the purpose of this report, a traffic simulation model is defined as a computerized analysis package that tracks the movements of individual vehicles in a model street network and quantifies the performance of the network by summing the results of individual vehicle movements. Examples of traffic simulation models include SimTraffic, CORSIM, VISSIM and Paramics. Traffic models that aid in computational tasks but do not track individual vehicle movements (for example, Traffix) were not considered to be traffic simulation models for the purposes of this paper. Furthermore regional travel forecasting models created using software such as TransCAD, TP Plus, and EMME II were not considered to be traffic simulation models in this discussion.

THE CHANGING WORLD OF TRAFFIC SIMULATION

One of the limitations of a paper such as this one is that traffic simulation models are continually being updated. Therefore, any comments in this paper about a particular simulation model may no longer apply if a new version is created by the developer. Furthermore, new models may be created that supercede the popularity of the traffic simulation models described here. While these limitations exist, the task force believed that the topic is important enough to create this description of the state of traffic simulation as it exists in late 2003 and early 2004.

ORGANIZATION OF THE HIGHWAY CAPACITY TASK FORCE

The Highway Capacity Task Force grew out of a workshop on highway capacity that was conducted as part of the June 2003 monthly meeting of the ITE California Border Section. Several attendees of the workshop believed that there were important topics in highway capacity to be discussed and that the discussion should continue beyond the workshop. In July 2003, a Focus Group discussion of the 2000 Highway Capacity Manual was held. Based on the discussion in the Focus Group, feedback was given to the Transportation

Research Board's Highway Capacity Committee, the committee responsible for maintenance of the Highway Capacity Manual. In August 2003, a task force of section members was formed to address local highway capacity issues. This paper is summarizes the work of the task force in the area of traffic simulation.

2. INTERNATIONAL RESEARCH ON TRAFFIC SIMULATION MODELS

There is a wealth of information on traffic simulation models available on the internet and in various research conducted by the transportation community. Anyone with access to the internet can do their own research by doing a search on traffic simulation using an internet search engine. In addition, there are on-line sources of information specifically devoted to transportation, such as the TRIS database, available on-line at http://99.79.179.82/sundev/search.cfm. While it was infeasible for the task force to provide a comprehensive description of previous research on traffic simulation models, it was considered desirable to provide a brief presentation of some of the materials we came across during the course of our work.

There were a few documents that present an overview of traffic simulation, listing the various models that are available and providing overall definitions. The two documents that were most useful to the task force were the following:

- Highway Capacity Manual, Transportation Research Board, 2000: The Highway Capacity Manual is well known for its procedures for traditional roadway capacity analysis, but it also includes a chapter on simulation, with general information, definitions, and receommendations.

- Micro-Simulation Tools on the WWW: Summary of traffic simulation models published by European researchers. The task force did not run across this paper in published form, but it is available on-line at www.its.leeds.ac.uk/projects/smartest. It includes descriptions of 32 traffic simulation models used worldwide.

Many documents are available that compare the results of different simulation models to each other or to more traditional traffic analysis methodologies. Examples of these types of papers include:

- Washburn, Scott S. and Larson, Nate, Signalized Intersection Delay Estimation: Case Study of Comparison of TRANSYT-7F, Synchro, and HCS, ITE Journal, March 2002.

- Milam, Ronald T. and Choa, Fred, HCM & CORSIM – Resolving the Differences, Compendium of Papers, Institute of Transportation Engineers, District 6 Annual Meeting, 2000.

Additional studies are available that provide guidance from the authors on how to apply traffic simulation models. One example is the following:

- Milam, Ronald T. and Choa, Fred, Recommended Guidelines for the Calibration and Validation of Traffic Simulation Models, Eighth TRB Conference on the Applications of Transportation Planning Methods, 2002.

3. OVERVIEW ON USE OF SIMULATION MODELS

This chapter provides an overview on the general advantages and disadvantages of simulation models and examples of situations in which task force members found simulation models to be especially beneficial.

Traffic simulation models allow the analyst to visualize existing and/or future traffic conditions, test strategies that would be difficult or impossible to test in roadway conditions, and analyze a wide variety of alternatives to a particular transportation problem. They have applications in alternatives analysis for transportation planning, optimization of traffic flow, bottleneck analysis, and traffic signal coordination.

Advantages and Disadvantages Compared to Other Methodologies

Traffic simulation models use computerized techniques to track the movements of individual vehicles through a street network. They use a system of rules that define driver behavior and vehicle performance. A traffic simulation model is operated by setting up a model street network, loading it with virtual vehicles, tracking the movements of the vehicles as they maneuver through the network, and summing the results of all vehicles to determine measures of effectiveness. Most traffic simulation models allow the analyst to create a real-time picture of the operating street network and observe vehicle interactions on the computer screen.

In contrast, more traditional roadway capacity methodologies can help predict the performance of a particular type of facility (intersection or roadway segment) through overall characteristics such as travel demand, type of traffic control, and number of lanes. With traditional methodologies, it is possible to input the overall characteristics of the facility and its traffic demand and determine overall measures of effectiveness such as level of service and delay. With traditional analysis, however, it is not possible to track individual vehicle movements.

Simulation models have the following advantages as compared to more traditional capacity analysis procedures:

- Ability to model an entire street network or facility and observe the effect of changes on one part of the network to the performance of the entire network.

- Ability to model the effects of queued vehicles on the performance of the facility. This includes simple queuing situations, such as short turn lanes, as well as more complex situations, such as ramp meters and the queuing of vehicles from a signalized intersection into an adjacent intersection.

- Ability to model unusual geometric or traffic control features (such as roundabouts, transit signal priority treatment, and pedestrians) that are not handled in traditional methodologies.

- Traffic simulation models that include a real-time animation of traffic allow non-technical audiences to visualize the potential results of alternative traffic scenarios.

Despite their strengths, simulation models have certain disadvantages:

- A great deal more time is required to analyze a problem with simulation models than with more traditional methodologies.

- Simulation models typically require more data than traditional methodologies.

- Small errors in setting up the parameters for the simulation can lead to large errors in the overall results.

- It is difficult to determine the accuracy of traffic simulation models. While all of the major software models currently in use are believed to be valid, there has been relatively little accuracy testing done by the transportation profession. In addition to the question of whether the software is accurate, there is also a question of whether the analyst has correctly applied the software. Accuracy is also a question in the use of more traditional methods, but they are simpler, easier to check, and have generally been in use in the profession for a much longer period of time.

- Because most simulation models use random number generation, the results will vary slightly for each separate run of a traffic simulation model.

Situations Where Simulation Models Are Beneficial

There are many traffic analyses that are better handled by simpler methods than traffic simulation. These usually include analyses of isolated intersections, studies conducted over a wide study area or with a large number of analysis scenarios, and any analyses conducted on a very limited budget.

Members of the task force have found simulation models to be most beneficial when one or more of the following situations occur:

- There is a well-defined and complex traffic operational problem to be solved.

- There are significant issues of queuing of vehicles from a particular intersection to adjacent intersections or from one roadway facility to another.

- There is a need for decision makers and/or the public and to visualize the results of a proposed improvement through a real-time animation.

- There is a great deal of cost difference between roadway improvements alternatives under consideration. In this case, the money that could be saved by making the appropriate decision tends to justify the cost of conducting the traffic simulation.

4. TRAFFIC SIMULATION MODELS IN THE SAN DIEGO REGION AND THE WESTERN UNITED STATES

This chapter presents the results of surveys of local agencies, local jurisdictions, and consulting traffic engineering firms within the San Diego region, as well as an internet-based survey of ITE District 6 (the 13 western states). The San Diego surveys were conducted in the fall of 2003. Because the task force was interested in gathering information on traffic simulation models beyond the San Diego area, a survey was also conducted of ITE members employed by public agencies within District 6.

LIST OF SIMULATION MODELS USED

The survey results indicated the following traffic simulation software packages as the most common in use or accepted within the San Diego region:

- *Synchro/SimTraffic (Trafficware, Inc.)* –SimTraffic is the traffic simulation portion of the Synchro software package. The Synchro software package performs intersection analysis using the Highway Capacity Manual methods, as well as ICU.

- *CORSIM* – CORSIM was developed by the Federal Highway Administration (FHWA), and is a more complicated model than SimTraffic. In addition to signalized intersections, CORSIM is able to model freeways, freeway ramps, ramp meters, and transit lines (LRT or BRT). CORSIM can be used to analyze networks that include freeways, interchanges and surface street networks. It can model queuing due to congestion and ramp meter effects.

- *VISSIM* – VISSIM is a product of Planung Transport Verkehr (PTV), a company located in Germany. Innovative Transportation Concepts (ITC) of Corvallis Oregon is the distributor of the software in the United States. In comparison to CORSIM, it has different areas of emphasis as well as a more elaborate display.

- *Paramics* – Paramics is similar to the VISSIM software, and is a product of Quadstone Inc, a company located in Scotland. Paramics is a simulation tool used by Caltrans for internal analysis.

SPECIFIC COMMENTS OF LOCAL AGENCIES AND CONSULTANTS

The following represents comments received from local agencies, jurisdictions, and practicing consultants regarding the traffic simulation software packages identified above. Please note that the following comments are listed for information only, and do not propose to indicate a software's superiority over another.

Synchro/SimTraffic

Advantages

- Synchro allows for full input of all parameters from the HCM.
- Synchro also allows for extensive adjustment of signal timing parameters.
- Synchro also allows for the analysis and design of coordinated signal systems, and has optimization features to develop optimal signal cycle lengths and offsets.
- Synchro allows for the modification of signal phasing, and the modification of ring and barrier diagrams, in order to create specialized custom phasing.
- Synchro also provides the ability to control multiple intersections from a single traffic signal controller.
- SimTraffic allows for adjustment of driver and vehicle characteristics (such as acceptable gaps, acceleration factors, average speeds), and allows for specifications of driver populations.
- SimTraffic is easier to use and allows visual simulation with less effort than many of the more complicated traffic simulation models.

Disadvantages

- The optimization of Synchro is not always consistent.
- Some bugs in the Synchro software; the identical input variables do not always yield identical results.
- A single Synchro file can only be used for one study scenario.
- SimTraffic is a very rudimentary simulation method.
- Synchro and SimTraffic cannot accurately predict operations in oversaturated conditions or account for queue overflow into through lanes.
- Because of its relative simplicity, SimTraffic has the potential for misuse. It allows the user to bypass the calibration/validation process to obtain immediate results with fairly simple inputs.

CORSIM:

Advantages

- Allows for timed and actuated signals and ramp meters
- Incorporates HOV and Transit components of traffic.
- Driver behavior parameters are adjustable to provide flexibility in calibration and validation.
- On-line help available via a message board on the FHWA web site
- Low cost of the software.

Disadvantages

- The integration of freeway and surface streets is done via interface nodes which can sometimes produce unusual results
- Limitations in the number of nodes, links and the number of vehicles in any simulation
- Animation graphics available in 2D only
- Cannot use GIS layers and/or ortho photos to help define inputs or reference animation output
- Cannot produce dynamic traffic assignment
- Extremely difficult to replicate severely congested links
- The input data is also more extensive and the time required to set up a CORSIM network is at least double the amount of time required for SimTraffic.
- Some users have commented that CORSIM does not have logical assumptions regarding driver behavior under extremely congested situations.

VISSIM:

Advantages

- Integrates freeways and surface streets seamlessly.
- Allows for timed and actuated signals and ramp meters.
- Incorporates HOV and Transit components of traffic.
- Integrates light rail and bus rapid transit systems with main traffic flow via signal preemption and priority.
- Driver behavior parameters are adjustable to provide flexibility in calibration and validation.
- Superior 3D graphics with viewing from any position and angle.
- Ability to “populate” non-transportation features such as buildings, trees and people for high-quality graphic output.
- No limits on number of nodes, links and vehicles on any simulation (limited by the hardware only).
- Dynamic traffic assignment – Ability to use OD trip tables.
- Can use GIS layers and/or ortho photos to help define inputs and reference animation output.
- VISSIM presents clear simulations, which are very useful in presenting proposed configurations or operations.
- VISSIM can be used to model complicated facilities, such as major freeway interchanges with ramp metering.
- VISSIM allows for adjustment of driver characteristics, gap-acceptance, yield locations and decision points.
- VISSIM had the ability to fully model BiTrans 233 signal controller programs, and other signal controller programs. This is especially useful in modeling unique phasing situations (such as the multiple timing bank functions and multiple preemption features of traffic signal controller programs).

- VISSIM can be used to model vehicle and transit operations, such as at-grade rail crossings.

Disadvantages

- In-depth knowledge of traffic engineering techniques required.
- High learning curve due to depth of software features.
- High cost of software.
- VISSIM is complex and requires extensive knowledge of the program and its features.
- The models used within VISSIM must be created with care, for minor inconsistencies between the model and the facility's design can result in major errors in the analysis.
- VISSIM analysis and simulation is based on gap-acceptance theories, and therefore the results may vary from HCM-based traffic signal operational analysis.
- Due to the number of variables within the VISSIM software, there are many opportunities for adjustment within the model (such as driver and vehicle characteristics, gap acceptance, yield characteristics, and speed change characteristics).

SAN DIEGO REGION SURVEY

In the fall of 2003, a survey was conducted of public agencies in the San Diego region who are members of the San Diego Traffic Engineers Council (SANTEC). Responses were received from 7 agencies. The results of the survey and a list of the responding agencies are included in the Appendix. Additional comments are summarized below.

A number of the respondents to the survey indicated that they had little or no experience with simulation models and software, mainly due to the complex nature and associated higher costs of running simulation models. Some of the additional comments received are listed below:

- ♦ Local jurisdictions or agencies may not have the resources to purchase or train staff with the most recent simulation software.

- ♦ The questions of "when" and "how" to use simulation software are still not easily answered.

- ♦ The lack of guidelines or parameters for the use of simulation software can lead to wide variations in results.

- ♦ Many of the common applications of traffic analysis software (i.e. environmental impact analysis of development projects) do not require simulation models.

- ♦ The Synchro software seems to be the most recognized software in the San Diego region; however, the visual simulation aspect contained in SimTraffic is not as commonly applied.

- ♦ The initial time and costs associated with purchasing and applying simulation models is often much greater than the cost for a traditional traffic operational analysis, and without a clear understanding of the benefits of the investment in a proper simulation model, it is difficult to justify the greater expenditure.

- ♦ Many local agencies and jurisdictions are concerned with the amount of adjustments that can be made to simulation models without being readily apparent to the reviewer, and therefore might influence their comfort level to make decisions.

ITE DISTRICT 6 SURVEY

In the fall of 2003, a survey was conducted of ITE members who are employed by public agencies within ITE District 6 (the 13 western states). The survey was initiated by the task force and conducted by ITE headquarters staff, who created a internet-based survey site and sent out an email requesting a response to the survey. The email was sent to 1,235 ITE members and 117 responses were received. At first glance, this would appear to be a low return rate. However, it is believed that the survey was not applicable to many of the potential respondents, because they work in areas of transportation analysis where traffic simulation is not used. A summary of the results of the survey and a list of agencies who responded to the survey are presented in the Appendix. A spreadsheet containing the individual results from all 117 respondents is available upon request from members of the task force.

Following are some of the conclusions reached by task force, after reviewing the results of the survey:

- , The results from District 6 were similar to the results received in the much smaller survey of agencies within the San Diego regions. Based on the results of the survey, SimTraffic is the most common simulation model in current use, while VISSIM, CORSIM, and Paramics were also mentioned by respondents in District 6 and the San Diego region.

- , FREQ and Integration were used by District 6 respondents, but were not mentioned by respondents in the San Diego region.

- , Several models that were used or owned by survey respondents did not appear to fall into the task force’s definition of traffic simulation models, highlighting the difficulty in developing a clear definition of traffic simulation.

- , Approximately 47% of the District 6 respondents expressed a preference for a particular simulation model. Of those, 61% preferred SimTraffic.

, Many of the respondents indicated that they did not have one overall preference for a particular model, but had preferences for certain models in certain types of situations. Respondents who preferred SimTraffic often mentioned, cost, simplicity, satisfaction with the results, and ease of use. Respondents who favored VISSIM, Paramics, or CORSIM mentioned accuracy or the ability to model special situations.

5. GUIDANCE ON THE USE OF TRAFFIC SIMULATION MODELS

The purpose of this chapter is to provide information and recommendations from the task force to anyone who is new to traffic simulation or who is seeking guidance on traffic simulation in general or a specific traffic simulation model. The chapter is divided into sections: Selection of a Particular Simulation Model, Input Parameters for Simulation Models, and Validation/Calibration of Simulation Models.

SELECTION OF A PARTICULAR SIMULATION MODEL

Many transportation agencies have standard traffic engineering tools that are specified for use in analyzing specific transportation problems. For example, many agencies in the San Diego region have specified the Highway Capacity Manual as the preferred methodology for capacity analysis of signalized intersections.

In the case of traffic simulation, most public agencies that the task force contacted have not specified a preferred traffic simulation model. The use of traffic simulation is relatively recent and the available models are continually changing as new versions are developed. Instead of specifying a particular simulation model for use throughout an agency or jurisdiction, the typical process appears to be that a simulation model is selected for use on a specific project based on a consensus of the individuals and agencies involved in the project.

This task force has also refrained from making any recommendations regarding preference of one simulation model over another. Our discussions and research have indicated that the various models vary considerably in cost, complexity, and characteristics and that the selection of a particular model depends on the situation. The information and resources described in Chapters 2 and 4 or this paper may be of value in assisting transportation analysts to come to an informed decision regarding the most appropriate simulation model to apply to a specific problem.

INPUT PARAMETERS FOR SIMULATION MODELS

Most traffic simulation models require a great deal of input data. Some of the required data and input parameters are well defined in the traffic engineering profession and others are specific to individual models. Accurate data and appropriate selection of input parameters can greatly affect the usefulness of simulation models.

In general, users and reviewers of the various simulation software packages and their respective output results should be aware of potential adjustments to the following factors:

- Peak Hour Factor (PHF);
- Saturation flow rates;
- Heavy vehicle percentages;
- Gap acceptance criteria for simulation vehicles; and

- Specific driver and vehicle operating characteristics (such as aggressiveness and speed/braking ability).

Minor adjustments to the factors listed above can result in dramatically different simulation and analysis results, and careful attention should be paid to the input parameters for each specific simulation project.

VALIDATION/CALIBRATION OF SIMULATION MODELS

The validity of a traffic simulation model's output is an important question in the decision of whether it is appropriate for use on a particular transportation problem. Simulation models that have been widely used in the transportation profession or that have been approved for use by a particular agency are generally thought to be reliable. However, no simulation model (or other analysis tool) is 100% accurate. Therefore, anyone using traffic simulation models would be wise to consider the question of accuracy and the need for validation of the results.

Both calibration and validation of simulation models are of interest. For the purposes of this discussion, calibration is considered to be the selection of input parameters to optimize the accuracy of a simulation model as compared to actual traffic conditions. Validation is the process of comparing a simulation model to actual traffic conditions to determine whether accurate results are produced.

Task force members who have wrestled with this issue have the following comments:

- Because of the complexity of simulation models, a small error in the input data can lead to large errors in the results (also known as amplification error). This is a common problem with computerized analysis tools, but in traffic simulation, it is particularly important to observe the results and apply quality control checks using judgment as well as comparative analysis using alternative techniques.

- It is necessary to validate both the measures of effectiveness produced by simulation models and the simulation graphics. For example, it is possible to have a model that accurately measures average speed on a roadway compared to field data, but does not accurately model vehicle interactions at a critical merge point. Conversely, it is possible for a model to accurately model vehicle interactions while containing an error that causes inaccuracies in the measure of effectiveness.

- Experience of an analyst with a particular simulation model in a variety of situations is one of the best ways to validate the results. Generally, traffic simulation models will be able to analyze certain combinations of roadway facilities and traffic conditions better than others.

- Oversaturated conditions represent a special challenge. Decisions need to be made regarding what happens to excess demand. In addition, driver behavior in congested situations can vary from the behavior that is observed in less congested conditions. It should not be assumed that a simulation model that can handle uncongested conditions can also represent congested conditions accurately. Analysts who are confronted with analyzing congested traffic conditions would be advised to have a good understanding of how well their simulation tool is able to deal with this type of situation.

6. SUMMARY AND CONCLUSIONS

This paper presents a summary of the current usage of traffic simulation models in the San Diego region and beyond. Key conclusions that can be drawn from this study include the following:

- Traffic simulation models continue to be created and those that are in use undergo continuous changes as developers of the models work to create the best possible product. Any of the discussion in this paper that is specific to a particular simulation model is subject to change as that model is revised and improved.

- According to the surveys conducted as part of this study, the most widely used simulation model in the San Diego region and in the Western United States is SimTraffic, followed by CORSIM, VISSIM, and Paramics. Many people who took part in this effort believe that there is no one traffic simulation model that is preferred for all situations and that all models have specific advantages depending on the particular traffic situation to be analyzed.

- While traffic simulation models offer significant advantages over traditional analysis methods in solving certain transportation analysis problems, they can also be misused and misinterpreted. Some of the more obvious pitfalls in using traffic simulation models are identified in this paper. The experienced analyst working with a particular simulation model will generally come to know its strengths and weaknesses through its application on a variety of transportation problems.

APPENDIX

SURVEY RESULTS

TRAFFIC SIMULATION MODEL SURVEY

SAN DIEGO TRAFFIC ENGINEERS COUNCIL (SANTEC)

Total Number of Responses: 7

1. Which of the following traffic simulation models does your agency accept for traffic studies done in your jurisdiction? (Check all that apply.)

_4_ Sim Traffic	_1_ CORSIM
_1_ VISSIM	_1_ Paramics
___ Integration	______ Other: ____________
______ Other: ____________	______ Other: ____________

2. Which of the following traffic simulation models does your agency own? (Check all that apply.)

_5_ Sim Traffic	_2_ CORSIM
__ VISSIM	_1_ Paramics
__ Integration	______ Other: ____________
_1_ Other: TransModeler	______ Other: ____________

3. Do you have one simulation model that is usually preferred over the others?

_1_ Yes (*)	_6_ No

If so, which one?

______ Sim Traffic	______ CORSIM
______ VISSIM	______ Paramics
______ Integration	______ Other: ____________

(*) One agency responded that the model preference depended on the type of roadway facility under study (VISSIM or Paramics for freeways and freeway/arterial networks and Sim Traffic for traffic signal networks).

LIST OF AGENCIES RESPONDING TO SURVEY

SAN DIEGO TRAFFIC ENGINEERS COUNCIL (SANTEC)

Caltrans, District 11
San Diego Association of Governments
City of Chula Vista
City of Escondido
City of La Mesa
City of National City
City of San Diego

TRAFFIC SIMULATION MODEL SURVEY

ITE MEMBERS EMPLOYED BY PUBLIC AGENCIES IN DISTRICT 6

Total Number of Responses: 117

1. Which of the following traffic simulation models does your agency accept for traffic studies done in your jurisdiction? (Check all that apply.)

90 (45%) Sim Traffic	48 (24%) CORSIM
37 (18%) VISSIM	11 (5%) Paramics
4 (2%) Integration	1 (<1%) TEAPAC
1 (<1%) FREQ	3 (1%) TRANSYT-7F
3 (1%) HCS	2 (1%) EMME/2
1 (<1%) HICap	1 (<1%) Traffix

2. Which of the following traffic simulation models does your agency own? (Check all that apply.)

85 (57%) Sim Traffic	29 (20%) CORSIM
12 (8%) VISSIM	7 (5%) Paramics
3 (2%) Integration	1 (<1%) TEAPAC
3 (2%) FREQ	2 (1%) TRANSYT-7F
2 (1%) HCS	1 (<1%) EMME/2
1 (<1%) HICap	1 (<1%) HCM/Cinema
1 (<1%) SIDRA	

3. Do you have one simulation model that is usually preferred over the others?*

49 (47%) Yes	55 (53%) No

If so, which one?

30 (62%) Sim Traffic	4 (8%) CORSIM
4 (8%) VISSIM	2 (4%) Paramics
1 (2%) TEAPAC	1 (2%) EMME/2
2 (4%) TRANSYT-7F	5 (10%) Other/Mixed Response

* Many respondents replied that they did not have one overall preferred model, but they had specific preferences, depending on the type of problem to be analyzed.

LIST OF AGENCIES RESPONDING TO SURVEY

ITE DISTRICT 6

ALASKA
Alaska DOT

ARIZONA
City of Lake Havasu
Maricopa County
City of Phoenix
City of Surprise
City of Tempe

CALIFORNIA
City of Bakersfield
City of Beverly Hills
Caltrans – District 5
Caltrans – District 6
Caltrans – District 11
City of Campbell
City of Ceres
City of Los Angeles
City of Moreno Valley
City of Monterey
City of Ontario
City of Pleasant Hill
City of Pasadena
Sacramento County
City of San Diego
City and County of San Francisco
City of San Jose
San Luis Obispo County
City of Temecula
City of Walnut Creek

COLORADO
City of Arvada
City and County of Denver
City of Fort Collins
City of Grand Junction
City of Greeley
Jefferson County
City of Longmont

IDAHO
Ada County
Idaho DOT

NEVADA
Clark County
Nevada DOT
RTC/Washoe County

NEW MEXICO
New Mexico DOT

OREGON
ODOT
City of Gresham
City of Portland

UTAH
City of St George
Salt Lake County

WASHINGTON
City of Bellevue
City of Bothell
Clark County
WSDOT
City of Everett
City of Federal Way
City of Issaquah
King County
Kitsap County
City of Moses Lake
City of Puyallup
City of Seattle
Skagit County
Snohomish County
City of Spokane

WYOMING
City of Cheyenne