

# **Innovative Methods to Collecting Data for Special Events and Modeling Travel Related to Special Events**

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## **Introduction**

The Maricopa Association of Governments (MAG) is the designated MPO for transportation planning for the metropolitan Phoenix area. The MAG Regional Travel Forecasting Model is the main tool utilized at the agency for long range planning and air quality conformity analyses. This model is a state-of-practice trip-based four-step model, and estimates travel demand for auto passengers and trucks for an average weekday. That is it predicts weekday travel with emphasis on peak weekday time periods and work trip purposes. The model design does not account for weekend travel and also does not explicitly consider planned special events travel on weekdays.

Currently there are more than 300 special events of regional significance that generate a total annual attendance of a few million people. In between 1999 and 2001, a number of data collection efforts and model development tasks were performed to estimate the potential Light Rail Transit (LRT) ridership for special events along the proposed 20-mile LRT corridor, and to enhance the representation of LRT alternatives in the regional travel forecasts. After the new LRT service opened in early 2009, the ridership numbers started to exceed regional forecasts along all LRT lines. Subsequently, an LRT intercept survey was conducted to collect information on trip purposes and modes of access. This survey data indicated that a significant portion of LRT riders were non-commute trips occurring during off-peak hours and weekends. The main reason for this phenomenon was due to the heavy utilization of LRT lines by special events patrons. The nature and location of special events in the Phoenix region has also changed significantly since the last special event survey. In order for the regional planning agencies to continue using estimates of transit usage at special event locations, it has become necessary to update the special event database and conduct another survey of patrons. The importance of this data for the purposes of transit planning was also recognized by the Federal Transit Administration (FTA) who is funding this project.

The travel associated with special events can produce significant, site-specific or even regional impacts such as severe traffic congestion or transit overcrowding. The special events related travel is also an essential part of planning for some of the new transit projects. This has been long recognized by regional planners and FTA. This project focuses on identifying special events in the region that affect transit ridership, collecting data related to travel associated with these events, and developing a stand-alone special events model. This stand-alone model will enable MAG and its member agencies to predict and analyze planned special events travel with an emphasis on transit applications and requirements related to the FTA New Starts and Small Starts application processes.

The paper focuses on the innovative aspects of this project that include classification of special events, data expansion of special event surveys, calibration/validation of the special event model, integration with the passenger model, and application considerations.

## **Classification of Special Events**

Modeling special events is complicated by the varying nature of individual events. Special events in the MAG region vary from weekend festivals that attract local residents to large

sporting events such as the Fiesta Bowl which bring thousands of visitors into the region for the one day event. Given the large number of special events that occur each year, it is not feasible to collect data and create models for each individual event. Therefore, we categorized the special events in the region by nine salient characteristics that will aid in data collection and model development:

- **Predicted Attendance:** Attendance is an important factor in classifying a special event as it can impact the transportation system differently. Very large events can lead to severe traffic congestion or transit over-crowding immediately before and after the event.
- **Event Frequency:** There are many recurring special events such as professional and college sports home games, college bowl games, concerts, theater productions, and conferences that occur at the same venue and have similar attendance levels. In contrast, some special events are a one-time event that have very unique attributes making it impossible to group the event with others.
- **Regular vs. Periodic Event:** Regular events are those that are typically available on an average weekday and the travel associated with such events should be captured in the existing regional travel model. On the other hand, the periodic special events do not occur on a daily basis and travel to these events is not typically captured in a regional travel model and should be estimated by a separate special event model.
- **Venue Type:** Most large sports and concert events take place at a single venue such as a stadium, arena, or theater, which causes significant traffic congestion and transit over-crowding closest to the event. In contrast, some events are multi-venue events since they take place at various locations throughout the region, which causes increased transit ridership across several transit lines and stops. A third venue type is the temporary venue, which are constructed specifically for the event and dismantled following the end of the event. These special events cause congestion to the road system due to closed city blocks.
- **Event Start and End Time:** It is very important to distinguish if the special event has a set start and end time, where all attendees arrive during a set time before the event and leave immediately after the event, or if the event has a continuous start and end time, such that attendees come and go throughout the duration of the event. Events with a set start and end time will have increased traffic on the transportation system immediately before and after the event. In contrast, continuous start and end time events may lead to increased ridership throughout the course of the day.
- **Single vs. Multiple Days:** Special events that occur on only one day such as concerts and most sports games will have different auto and transit shares compared to multiple day events that occur over the course of a few days or weeks.
- **Day of Week:** Weekdays, Saturdays and Sundays have different transportation system characteristics, and therefore, it is important to distinguish between special events that take place during the week versus on Saturdays or Sundays.
- **Event Market Area:** Some special events have attendees that are mostly residents of the Phoenix area, whereas other special events, such as large sports events and conferences,

attract attendees from all over the State and Nation. Local/regional events can assume that all attendees have a home residence within the Phoenix area. For statewide/national events many attendees will be traveling from out of the region to attend the event and will spend the night at a hotel.

- **Local vs. Regional Attendance:** Certain special events attract attendees from all over the region which can be categorized as regional attendance events. For these events, trips to and from the event will be distributed across the region. Other events are more localized in their attendance such as local shows and festivals that attract attendees that originate closer to the event venue and would be characterized as a local attendance event.

## Special Event Survey Data Collection

### *Short listing special events*

The first step towards data collection at various special events was compiling all the major special events in the region that attract at least 1,500 patrons. This yielded a list of over 300 events in the region, which was categorized into the aforementioned nine groups. Given the resource constraints, it was decided early on that it would be possible to collect special event surveys for about 15 to 18 special events. Therefore, the following criteria were employed to short list events where data collection was necessary:

- It is very important to capture the impact of special events on the transit system, so priority was given to special events that are on the LRT line or have the potential to be connected by LRT in the future. Consideration was also given to those events that have other transit (bus) access as well. Over half of the events chosen were within one mile of an LRT station.
- There are several large stadiums and sports complexes in the MAG region. Therefore, at least one special event from each of these large complexes was chosen. Other events that were known to have a very large attendance size were also chosen.
- It was desirable to capture special events from a wide geographical range within the MAG region. The short-list of events includes events in nine different cities.
- The group of events was chosen so as to have a good representation of each of the nine special event types. This included surveying weekday, Saturday, and Sunday events, including small local events, as well as large regional events, and including at least one temporary venue. A wide variety of events were chosen including a marathon, a block party, concerts, festivals, conventions, and a variety of sporting events.
- The special events chosen were selected so as to spread the events over the course of an eight month period from September 2009 through April 2010.

### *Challenges during data collection*

The survey process began with a pre-test which provided invaluable insights into the way questions need to be framed, response rates, survey techniques, and various challenges faced

during data collection. Subsequently, these findings were used to modify the survey methodology and instrument. So far, full surveys at two special events were completed out of the planned 18 special events. Listed below are the main challenges that we faced that are not typical in other surveys, and the remedies we came up with to address these using innovative ways of collecting data:

- The first and foremost challenge in this study is getting permissions from the events to conduct surveys. So MAG officials of significance were called upon to make the necessary contacts to obtain permissions either directly with the event staff, or through the local Chamber of Commerce and/or City officials. If permission is denied, then we plan on conducting the surveys close to the event venue but not on their property. This includes places like sidewalks, nearby parking lots and transit stops/stations.
- Each event is different and attracts a wide sociodemographic profile depending on the type of the event, which makes it harder to get a representative sample. Therefore, large enough samples are being targeted so that we can achieve the desired statistical significance at a reasonably low margin of error.
- Surveying at all entry and exit gates is difficult as VIP gates are not permitted to conduct any surveys. However, this is a small sample of the total attendance at the event and it will not bias the sample in a significant way.
- Obtaining the exact address of home was a big challenge as many respondents, for confidential reasons, would give only the closest cross-street information. But geocoding such responses and determining a unique zone for these locations is extremely hard. So whenever cross-street information was obtained, the respondents were also asked to provide the directional quadrants which was used to assign the most logical zone associated with each respondents' origin and destination.

### *Survey data expansion*

Several expansion techniques were explored and it was determined that the best way was to develop event-specific expansion factors which will be stratified further by time period and entry/gateway to the event. Data on attendance will be collected from local agencies and event venues, in addition to collecting count data at the event facility. In order to accomplish this task, accurate estimates of number of people entering the special event facility at every entry point or gate need to be collected. In this approach, not only should we survey at all entry points or gates, but also collect counts of people from start to finish at every entry or gate. As we are also planning on conducting the surveys at various time slots for all events, this approach will enable us to expand the data by gate as well as by time period. This is a rather expensive process, and will also require permission to survey and position counters to collect count data at all entry points. Therefore, this approach is possible only for a select set of events where we can easily position staff at all entry points as well as allocate staff resources to collect count data. For those events where this approach can not be used, we will rely solely on the total attendance on the day the special event takes place.

## Special Event Model Development

### *Integration with passenger travel model*

The special events model (SEM) is designed very similar to a daily model but will be applied separately to each type of special event and for each day of week (weekday, Saturday, or Sunday). The following SEM components will be developed:

- **Trip Generation:** Given the unique nature of special events, the number of person trips can be estimated directly from the predicted daily attendance at the event or based on the capacity size at the event locale. The second part of trip generation, is allocating trips to trip purposes. For local/regional events the trip purposes will be grouped into home-based, work-based, and other-based. For statewide/national events, the other-based trips will be further divided into hotel-based and non hotel-based. It should be noted that the SEM will be structured in such a way that all trip productions occur at the venue and all trip attractions occur away from the venue. Therefore, output from the trip generation step will be total number of home-based, work-based, and other-based trips (or hotel-based and non hotel-based trips, where applicable) being produced by the event.
- **Trip Distribution:** The survey data will contain geocoded information for previous locations and post-event locations. These locations will be linked to MAG zones prior to distributing the special event trips to these locations. Destination choice of these special event trips will be modeled using a logit formulation. Since all trips are produced at a single known location, it is necessary to model only the location of trip attractions. Separate destination choice logit models will be estimated for each trip purpose, for each day of the week (weekday, Saturday, or Sunday), and for local attendance and regional attendance events, separately. Local attendance events will be modeled separately from regional attendance events because the location of local/regional trip attractions will be concentrated in close proximity to the event location. Regional attendance events may also have a certain percentage of trips that originate outside of the MAG region.
- **Time-of-Day:** Modeling time-of-day is important for modeling weekday events that result in travel during the peak period and for air quality analysis of weekdays and weekends. For events with a set start time, time-of-day is assumed to be distributed within a set period before the event start time. Events with a continuous start and end time will have arrival and departure times that vary throughout the course of the event. The distribution of the start times and end times will be determined and allocated based on the survey data.
- **Mode Choice:** Logit mode choice models will be estimated from the survey data, to be applied to the trip tables estimated in the destination choice component. Separate models will be developed for each trip purpose, day of week, and time-of-day. Based on the availability of enough samples for each submode, as well as reviewing the estimation results, the best possible model structure in terms of nesting of the submodes will be developed. Before highway assignment is performed on the auto trips, the auto person trips must be converted to vehicle trips, based on the proportion of single occupancy, two-person shared ride, and three or more person shared ride trips, to ensure that auto trips are not over-assigned to the highway network. The mode choice outputs will include transit person trip

tables and drive alone and shared ride vehicle trip tables for each peak and off-peak period for weekdays, Saturdays, and Sundays.

- **Highway and Transit Assignment:** The resultant trip tables from the mode choice procedure will be fed into the existing highway and transit assignment procedure for MAG's Four-Step Weekday Model. For weekday events, the existing weekday highway and transit skims will be used. For weekend events, either weekend skims will be used, if available, or the non-peak weekday skims will be used. The SEM also will include feedback procedures between assignment and trip distribution to recalculate travel time impedances, and between assignment and mode choice to account for increased congestion on the highway or transit system due to the event.

The modeling process described above is designed for projection on a daily basis, and therefore, each individual event is modeled. The SEM will be developed as a stand-alone model in TransCAD GIS-DK scripts. The SEM will be designed so that it can readily be integrated into the existing MAG travel model and, to the extent possible, the proposed future activity-based modeling process.

#### *Calibration/validation of SEM*

It is important to validate the model using sources of data that differ from those used for model development and estimation. Four independent data sources will be used to validate the SEM as described below:

- **Special event venue parking data:** For the purposes of validation, we will obtain parking capacity and usage information for the events. Usage data and capacity information will then be used as a validation measure to check how many autos access the facility. This information will be compared against the number of auto trips predicted by the SEM. The parking data may also be used to conduct sensitivity analysis on forecast years to see how varying parking costs and availability will impact transit ridership.
- **Transit boarding counts:** Transit boarding counts will be provided by Valley Metro on major bus routes serving special events, as well as light rail ridership data. Transit data on non-special event days will be compared to transit data on special event days to determine the affect of the special event on transit ridership. These counts will also be used to validate the transit assignment results for the base year.
- **Percentage of survey data:** Prior to model estimation, the survey data will be split into two parts. One part will be used for model estimation and the second part will be used for validation. The survey data saved for validation will then be used to validate the trip generation, trip distribution, time-of-day, and mode choice components of the SEM. This process will make certain that data is available for validating the SEM, but will ensure that the data used for validation is not identical to the data used for model estimation.
- **Review of other studies:** Literature and data will be obtained from other regions who have developed special events models or can provide information on travel to special events. Information collected from other regions will be used for reasonableness testing of the

SEM. While every region has unique travel characteristics, comparing the SEM results to other regions will help identify if the model is producing reasonable results.

The datasets identified above will be used to validate the SEM, and will be used for sensitivity and reasonableness testing for the base and future years. Based on the results of model validation adjustments and recalibration of the SEM model will be implemented, where necessary.

### *Special event model application*

The SEM is being designed as a regional model. It will be able to serve as a forecasting and scenario-testing tool for current and future planned special events. The model is a stand alone forecasting procedure, but it can be integrated within weekday trip-based modeling framework. One of the long-term goals includes utilization of the developed SEM approaches and collected data for the activity-based modeling framework. As the SEM is being designed to handle all types of events, the application can also be done specific to each event type. That is, if MAG desires to analyze different future LRT alignments for a particular event, then the SEM for that event can be executed and integrated with the MAG's travel model. The SEM application can also be done based on the day of the week as special events occur on both weekday and weekends.