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Development of Weekend Travel Demand and Mode Split Models
Technical Memorandum (TM) III*

State of Practices In Weekend Travel Demand Forecast

Submitted

By

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1. INTRODUCTION

Development of weekend travel demand and mode split model includes two interrelated steps: the first step is to understand the dynamics behind the travel behavior for weekend travel. It includes exploring the similarities and differences between weekday and weekend travel, identifying important factors that affect the travel demand and investigating mode choices of individuals. The second step is to develop tools, such as network or spreadsheet models to simulate the travel behavior or validate the hypotheses that researchers have established in step one.

The research team has already evaluated travel demand models in and around New Jersey as part of Task 2 of Weekend Travel Demand study. This Technical Memorandum documents two other broad surveys outside New Jersey to gather the state of practice of weekend travel demand forecasting. The first survey was conducted using the Travel Model Improvement Program (TMIP) list server, an Internet discussion group by modelers, ranging from academia, consultants, and government employees. The second survey was distributed among selected Metropolitan Planning Organizations (MPO) in North America to gather the current status of weekend travel demand and forecast models.

2. TMIP DISCUSSIONS

The Travel Model Improvement Program (TMIP) is a program established about ten years ago by Federal Highway Administration (FHWA) to help planning agencies improve the techniques they use to inform their decision makers on how growth in population and employment, development patterns, and investments in transportation infrastructure are likely to affect travel, congestion, air quality, and quality of life. In order to advance the state of the practice of travel modeling and planning analysis, TMIP provides a variety of services to academics and professionals in the fields of travel modeling and planning analysis, which ranges from seminars and training, email list, clearinghouse, research, and peer review and exchanges (USDOT, 2006).

The TMIP E-mail discussion list is subscribed by more than 700 members of the travel forecasting profession from around the globe. Users post issues or questions to the list initiating discussions among the membership. TMIP list server maintains a continuous, active discussion group on various subjects directly related to travel demand modeling, and many hot topics in analysis and modeling are discussed through the list server.

In April 2006, Dr. Liu, the Principal Investigator of the project, posted an invitation of discussion on weekend travel behavior and forecast model as attached in Appendix 1. The email asked about three aspects of weekend travel demand

modeling: current weekend modeling development, factors that impact weekend travel, and data collection on weekend travel characteristics.

The Email invitation has stimulated interesting discussions among modelers from all fields, ranging from MPO staff, academia, and consultant. The micro simulation model of weekend travel by household in Calgary had been identified as in the most advanced stages of modeling development by a local MPO, which is elaborated in a section of this TM. A series of travel behavior and transit on-board surveys that included weekend element has also been revealed, which are included in a later section of this TM, too.

2.1 The Differences between Weekday and Weekend Travel

One of the important contributions from this list server discussion is the unique characteristics of weekend travel and its spatial and temporal distribution in various geographic locations. As pointed out by one of the responses, (Leve, 2006), there are quite a few cities where significant numbers of people leave the urban area on weekends, typically for various activities associated with "time in the country". The traffic patterns associated with large numbers of people leaving on Friday evening, and to a lesser extent early on Saturday morning, then returning on Sunday evening are quite different from typical weekday traffic patterns. Nevertheless, these traveling characteristics may cause quite significant and extensive congestion. In addition, this congestion may be more perceptible in outlying areas which do not "normally" have congestion problems.

The "weekend tourist" type of travel behavior is certainly more common during the summer months when atmospheric conditions may amplify the effects of local ozone concentrations. In terms of modeling this type of trip, often there is a reasonably well defined "area" outside of the city which is attracting many trips and the challenge is to predict who might be going to this area and from where.

Based on his analysis of San Francisco data, Lockwood, et al (2004) have summarized the following broad numbers comparing weekend day travel to weekday travel:

1. Average number of out-of-home activity episode participations per capita (individual) - 2.11 (average weekday), 1.91 (Saturday), 1.71 (Sunday).
2. Average number of daily person trips per capita - 3.40 (weekday), 3.14 (Saturday), 2.85 (Sunday)
3. Person miles of travel (PMT) per capita - 22.85 (weekday), 21.97 (Saturday), 20.40 (Sunday)
4. Vehicle miles of travel (VMT) by motorized personal automobiles per capita - 15.57 (weekday), 13.36 (Saturday), 12.10 (Sunday)
5. Peak period (defined as more than 23 trips ending per 100 individuals in the population) - 7-9 AM and 3-7 PM (weekday), 11:45 AM-6:15 PM (Saturday), 11:45 AM-2 PM and 3-4 PM (Sunday)

6. Peak of the peak (defined as more than 30 trips ending per 100 individuals in the population) - 7:45 AM-8:45 AM and 5:15 PM-6:15 PM (weekday), none at this intensity level on the weekend days.

A comparative analysis of the weekday and weekend activity-travel participation behavior indicates that the total volume of travel undertaken during weekdays and weekend days are comparable. The total person miles of travel (PMT) is about the same on a typical weekday and on weekend days, while the total vehicle miles of travel (VMT) on Saturdays (Sundays) is about 86% (77%) of weekday VMT. The consensus based on the survey responses suggests that, at the least, weekend activities and travel need some more attention.

2.2 The Importance of Analyzing Weekend Travel

Another important result of this list server discussion, after identifying various sources of modeling development and data availability, is the reassurance of weekend travel demand forecast and mode split analysis, as well as its overall impact on the long range transportation planning process.

The characteristics of weekend and weekday travel are quite different, as pointed out by various responses in the list server discussion. There could be unique traffic generators, such as sporting events and concerts, during some weekends resulting in traffic congestion at different network links to those that are congested during the typical workday traffic profile.

The differences between weekdays and weekend days, especially in the temporal profiles of the travel patterns, may have implications for air quality modeling. Specifically, the sustained high volume of weekend trips during the hotter, *i.e.*, mid-day, period can amplify the severity of the impact of emissions on air quality. Further, as a consequence of departure from home much later in the day, compared to weekdays the longer soak times of vehicles prior to first use during weekends, could also increase air pollution from emissions. As pointed out by Dr. Bhat, of the three days exceeding the 125 Parts Per Billion (ppb) ozone level non-attainment standard in the Dallas-Fort Worth area in 2003, two were weekend days, according to an NCTCOG report.

Furthermore, when looking at permanent vehicle recorder stations on interstate highways in many portions of the State of Washington, Shull (2006) stated that the highest travel hours are very often on the weekends. Yes, this reflects a high degree of intercity travel, but again it shows that we must pay attention to more than the typical weekday. As we extract the last bit of capacity from our systems by using former shoulders as lanes, etc, we need to keep in mind that the incidents, special cases, holidays, disasters, etc. will continue to require more and more of our focus (Shull, 2006). It is also possible that transportation control measures intended to regulate traffic flows on weekdays might transfer traffic to weekends.

On the other hand, a number of participants have explained why, rightly or wrongly, not much effort has been placed towards development of Saturday or Sunday travel models. According to Cervenka (2006), in all of the high-growth, low-growth, or no-growth areas, most model applications are still very much focused on finding solutions to congestion and accessibility issues. In other words, a new roadway or rail system is built primarily to relieve current/projected weekday peak period congestion, but this is sometimes influenced by the simpler desire to provide faster or alternative service even in the off-peak hours. The speculation is that even the "30th highest hour" calculations that design engineers love to use wind up almost always being peak hours on weekdays, notable exceptions being roadway designs for special events, traveling to the beach, treatments around regional shopping malls, etc. Therefore, with the exception of these very special localized situations, the implication is that if a transportation system can "handle" weekday peak hour conditions, it will "handle" any weekend condition. The fact that some summer-time ozone pollution exceed the allowable level take place on weekends is definitely something that needs to be taken seriously in the planning process, but in reality, these probably are primarily a result of very unusual atmospheric conditions that get combined with a transportation system that can already be shown to be problematic because it also has lots of unacceptable weekday ozone levels.

2.3 The Scope of Weekend Travel Demand Model

The overall responses from the TMIP discussion is optimistic toward the need and purpose of the weekend travel demand forecast and mode split model, but cautions need to be exercised on the scope and investment. As suggested by Cervenka (2006), a clear purpose needs to be stated, before substantial investments are made in the development of weekend-based models. Perhaps what is needed are not full regional weekend models, but "special event" and "sub-area" types of models in which the survey/data collection program can be focused on well-stated objectives.

Since air quality is typically associated with the summer season, it is also suggested that one of the bigger deficiencies in current regional modeling activities is that they are often based on "weekday while schools are in session" non-summer time traffic. We certainly need to acknowledge some of the very strong, and philosophically correct, arguments that are made from time-to-time in support of weekend modeling and weekend-based "problem resolution". That is, even minor, under the limit, ozone situations on summer-time weekends are especially detrimental to a region's health because there are more people spending time outdoors on weekends. If one is to develop a weekend model, perhaps it needs to be specifically a summer-time weekend model.

3. MPO SURVEY

As stated in the scope of this research, most existing transit, MPO, and statewide travel demand models, including all of those we are familiar with in New Jersey, explicitly model non-work travel purposes as well as include both peak and off-peak periods, but for a typical weekday. However, systematic or general methodology for estimating travel demands, and mode choice in particular, do not exist for weekend travel analysis, which we know is dominated by non-work travel as well as very specific peak and off-peak periods quite different from weekdays. It is our understanding that improvements in the analysis and forecasting of weekend travel and transportation impacts are the primary focus of this research project.

An in-depth survey is conducted to find out the state of practice both in New Jersey and elsewhere. The research team selected top 45 MPOs in terms of population and 20 MPOs responded. Appendix 2 documents the individual MPOs we have surveyed and entities that responded to our survey.

As recorded in Appendix 2, the MPO survey intends to gather weekend travel demand analysis based on two large focuses. The first focus deals with the current status of weekend travel demand model, data collection and travel behavior, particularly on mode share as addressed by the first four questions. The second focus is on the future plans of each MPO whether they plan to develop a weekend model, are there any factors they think are important to forecast weekend travel, or any modeling structure they would like to suggest. The following section summarizes the results based on the two focuses.

3.1 Current Landscape of Weekend Travel by MPOs

None of the MPOs surveyed has a weekend travel demand forecast module in its Long Range Transportation Plan (LRTP) model. However, Southern California Associations of Government (SCAG) is planning to issue a Request for Proposal (RFP) for developing a weekend travel demand forecast. The weekend forecast model will be parallel to its original weekday model and based on a four-step forecast structure. The driving force behind this initiative is clearly concerns for air quality in various corridors. Many of the days that exceed air emission standards in southern California area are on weekend days.

Among the 20 responses to the survey, four have done individual household travel behavior surveys since 1995. Among these household surveys, weekend travel information has been collected by South California Association of Governments (SCAG), Metropolitan Transportation Commission (MTC), Atlanta Regional Commission (ARC), and Oregon Department of Transportation and Service of Metropolitan District. Most of the data set and summary reports of the household surveys are accessible from internet, except the data set from SCAG.

It is interesting to note that these household surveys which contain weekend travel information are done in similar formats. For example, a two-day travel diary was collected for each member of the household. The combinations of two-day diary include: Sunday and Monday, Monday and Tuesday, Tuesday and Wednesday, Wednesday and Thursday, Thursday and Friday, Friday and Saturday. Researchers usually single out travel information on Saturdays and information on Sundays to compare with the rest of weekday travel characteristics. More data summary is presented in the following section of this Technical Memorandum.

Survey asked the MPO staffs to compare weekend travel and weekday travel in its region. Most survey respondents emphasized that the traffic condition on weekends is based on their own experiences rather than collected data or analysis. MPO staff observed different travel patterns on weekends and weekdays, even without solid data back up. For example, one of the MPOs in Illinois reported that shopping and other major destinations attract higher volumes/ridership on weekends, depending on the facility and time of day. One of the MPOs in the north west region found that weekday and weekend congestions have different locations, some of the facilities are more heavily congested over the weekend. Another MPO in northeast observed different functions of highways, such as commute oriented highways and more vocational oriented highways. For the commute oriented highways, volumes are lower on weekends. However, depending on the time of the year, the more vocational highways can expect more volume on weekends, such as I-495. This is used by many New York and New Jersey people traveling to Maine in the summer.

Weekend traffic congestions also arises concerns for air quality. One of the MPO in Texas “deals” with Saturday and Sunday travel by applying time-of-day factors to weekday travel numbers for air quality purposes. The responses from the survey further confirm the observations in the literature that the travel characteristics and dynamics of weekdays and weekends are likely to differ and there is a need to develop new models that more accurately predict travel needs on weekends.

Based on different traffic demand on weekends, planning organizations show different levels of interest about weekend travel demand modeling. For regions where traffic on weekends is low, planning agencies have no plan to include weekend travel information in the data collection process in the near future. The planning agency for a region such as SCAG, where traffic in many corridors is as heavy on weekends as on weekdays, is moving forward to develop a weekend demand modeling to incorporate into its weekday module. Weekend travel demand is also driven by air quality concerns. One of the MPOs on Texas mentioned that air quality breaks often on weekends. Another MPO in Texas plans to figure out a more sophisticated way of factoring our weekday model so that it can represent weekend conditions for its air quality work. However, interest

in weekend travel model development is also constrained by funding available and policy concerns. One of the MPOs in Texas reported that traffic volume on weekends in some of the corridors within its planning region, is heavier than volume on weekdays. However, because of funding restrictions, a proposal to assign half of the samples on weekends in the next round of household survey was turned down. Also, one of the MPOs in California observed several busy corridors on weekends, but, the respondent added: “they are not policy concerns right now.”

In terms of mode split, only a few agencies answered. The low response rates on this particular question might be driven by the dominate mode share in most areas being automobiles, therefore, the neglectable impact of other modes, and eventually lack of data. However, the overall impression from those who responded is that transit use is less on weekends, while shared ride is more. Some responses mentioned that transit design is usually CBD oriented, serving work or school trip purposes, instead of recreational trips. The transit mode share from those who responded ranges from 1.5% to 2.5%, except New York City. One of the MPOs in the west coast mentioned that weekend trips involve a lot less transit shares, but a lot more shared ride. Transit services in the region do not serve the nature of the trips on weekends. The only exception is during the football game on weekends, when extra commuter cars are put into service to transfer people from remote parking. Another MPO in the southern region mentioned that transit usage is much heavier on weekdays for school and work, recreational trips do not use transit much. Transit ride share also depends on its level of service. A MPO in the mid-east mentioned that “transit access is not very good. The light rail is downtown oriented, so it serves mostly weekday work travel. On weekends, it serves with very limited headways.”

3.2 Future Plans for Weekend Travel Demand Forecast

Most agencies, except SCAG who is ready to initiate a RFP, do not have a plan to incorporate weekend travel into their current travel demand forecast mode/split models in the near future. They do not have a clear plan for developing weekend models either. However, further probing indicates that more and more agencies, especially those in large metropolitan areas, are confronted by various congestion problems that occur in non-traditional, outside of peak commuting periods. Some of the agencies, such as Houston Galveston Area Council, has developed factors to reflect the air quality conditions, While others, such as Maricopa Association of Governments, is contemplating the options of incorporating the weekend travel by capturing recreational behaviors.

On the other hand, most MPOs have put the weekend travel demand forecast model on the back burner. For example, a staff from SEMCAP mentioned that we may consider it after this round of RTP process. Another staff from Sacramento Area Council of government mentioned that they are currently developing an

activity based model and hoping that it will be a better base for weekend travel demand forecasting.

The responses mentioned a wide variety aspect for factors that affect weekend travel characteristics, which are consistent with the factors we have discussed in the Technical Memorandum I. The most recognized difference between weekend and weekday travel is the trip purpose. A number of respondents mentioned more non-working, recreational trips on weekend, more trip training and higher occupancy rate on weekend. Another frequently mentioned characteristic of weekend travel is the temporal distribution. Most responses emphasized the seasonal changes of weekend travel, differences between Saturday and Sunday, and peaking characteristics of each weekend day, which are different from weekday traffic distributions. An example from the west coast demonstrated that ferries are more congested in summer season. Other factors suggested by the survey participants include trip purposes, travel length, life style, current traffic, and auto occupancy.

The consensus is clear that the first step to understand people's behavior over the two weekend days is a household travel behavior survey to capture the entire period from Friday afternoon to early Monday morning. However, as demonstrated by one New Jersey respondent, a local household travel behavior survey may not provide enough data since recreational attractions might also attract people from out of states, so he suggested that an external cordon survey might need to be included.

The suggestions for the modeling structure, ranged from applying a simple factor to complex four step models, to tour or activity based models. The majority responses are along the line of traditional four step models with emphasis on trip generation and mode split steps. A number of responses identified activity or tour based and also recognized the increased cost and effort to develop such models. Is there a consensus? It has largely to do with questions that are to be answered, as rightly pointed out by one respondent. For example, weekend congestion around regional shopping centers or tourist destinations could be analyzed by assigning estimated trip tables from traffic counts. Analysis of weekend regional air quality concerns could require traditional four step models.

3.3 The Roles of Special Generators

As directed by the project client, New Jersey Transit, we have added a question on special generators to the MPOs that we have surveyed in the later stages. As expected, a number of land use types have been modeled by various travel demand forecast models, ranging from airport, medical centers, colleges, ports, stadiums, retail malls, science centers, and downtown centers. One of the MPOs in Texas included non-residential adjustment by factoring hotel room occupancy rates. Another MPOs in Arizona estimated trip generation rate for airport and universities using gross factors. The Puget Sound Regional council actually

modeled three major exhibition locations not for their sporting functions, such as football, baseball but when they were used for exhibition purposes. The gross factors for trip generation based on exhibition function are derived from regional population bases. The same MPO also modeled ports for heavy truck traffic since over the years, port volume has increased twice as fast as the population.

To obtain a general trip generation rate for various land use types, the research team has compiled a trip generation table with both weekday and weekend characteristics based on ITE trip generation manual (ITE, 1998). As shown in Appendix 3, different trip generation rates for weekend and weekdays are observed and collected for various ports and terminals, industrial, agricultural, residential, lodging, recreational, institutional, medical, office, and retail establishments.

A general analysis revealed that a few selected categories, such as church, Cemetery, Beach Park, State Park, National Monument, nursing home, motel and military base all have higher trip generation rates for at least one weekend day than weekdays. On the other spectrum, warehouse, industry park, office park, daycare center, general light industrial park, business park, high school, truck terminal, manufacture, and library all have significant lower weekend trip generation rates than weekdays. A mixed picture has been observed for other categories, such as hotels, Universities, hospitals, and planned unit residential development, where the weekend attractions can be any where between 50 to 120 percent of weekday volume.

Given the ranges of the modeling structures suggested, the research team concluded that the factor approach is probably the least expensive and easiest to accomplish. However, it will not capture the differences between weekday or weekend travel behavior and unique spatial and temporal distributions of each. The activity and tour based model may be expensive and time consuming to accomplish, however it will provide the most comprehensive understanding of weekend travel and produce reliable travel demand forecast for the future. But it demands extensive data collection and may encounter difficulties to be incorporated within the routing modeling structures in New Jersey MPOs.

New Jersey Transit is concerned that the weekend mode split may be different from the generally perceived patterns observed in other places. The focus of this project is to capture the true differences in mode share between weekday and weekends, the research team is suggesting an approach to start with a basic four step modeling structuring with emphasis on special generators, which have the potential to attract more weekend travel than weekdays, and more non-working trip than commuting trips. Another emphasis of this approach would be placed on mode share on weekend. A series of surveys and analyses should be included to prove or disapprove that mode share on weekend is different from weekdays, and the actually patterns and magnitude of each.

4. WEEKEND TRAVEL DATA

As mentioned repeatedly in both surveys presented in last section, household surveys are important resources that provide us with valuable information about travel preferences and demographic information across the population. This section described two major series of data that directly deal with weekend travel and are available to the research team.

4.1 Household Travel Surveys

In order to store, preserve, and make the resources more publicly available, Bureau of Transportation Statistics and the Federal Highway Administration have funded a project at the University of Minnesota to develop a Metropolitan Travel Survey Archive. The databases along with relevant documentation for many regions were posted at <http://www.surveyarchive.org>. Presently there are over 60 surveys from 28 metro areas and states together with documentation and reports available on the project web site. Among these data sets, the research team has identified five set of surveys that have weekend travel data since 1990s, as listed in Table 1.

Table 1. Household Travel Surveys Including Weekend Data

Agency	Major City	State	Year
Southern California Association of Governments	Los Angeles	CA	2001
Metropolitan Transportation Commission-Oakland	San Francisco	CA	2001
Atlanta Regional Commission	Atlanta	GA	2001
City of Calgary	Calgary	Canada	2001
Metro	Portland	OR	1994

Four of the five sets of household travel surveys were conducted in 2001 and one in 1994. The four surveys in the United States used similar format, travel dairies for two consecutive days of the week and City of Calgary used a one day dairy. That is a “two-day activity diary” was collected by each of the survey. Each individual in the households was required to submit a complete diary records of all travel made for a 48-hour period. For example, households might be assigned to record their travel information on Sunday and Monday or Monday and Tuesday. However, each individual provided information on only one weekend day in the survey (i.e. an individual was surveyed on either Friday and Saturday or Sunday and Monday, but not on Saturday and Sunday).

Atlanta Household Travel Survey, conducted in 2001, was to be used in calibrating travel demand models for travel forecasting, land use planning, and air quality planning for the 13 counties in the Atlanta region. A total of 8,069 Atlanta households, representing 0.5% of total households in the metropolitan area, participated in the survey, which included 18,326 persons, 15,050 vehicles, and 151,401 places visited during the 48-hour travel period.

A typical format used in two day travel diary is demonstrated in Appendix 4, the travel diary used in 2001 Atlanta Household Travel Survey. The information collected in the survey includes type of activities, the type of activity participation locations, departure and arrival times of activity participation, and the geographic locations of activity participation, as exhibited in Table 2. The survey also collected data on individual and household socio-demographics, individual employment status, dwelling type and household vehicle ownerships.

San Francisco Bay Area Travel Survey (BATS) conducted in 2000. This survey was designed and administered by MORPACE International Inc. for the Bay Area Metropolitan Transportation Commission. The survey collected information on all activity and travel episodes undertaken by individuals from over 15,000 households in the Bay Area for a two-day period

The information collected on activity episodes included the type of activity (based on a 17-category classification system), the name of the activity participation location (for example, Jewish community center, Riverpark plaza, etc.), the type of participation location (such as religious place, or shopping mall), start and end times of activity participation, and the geographic location of activity participation. Travel episodes were characterized by the mode used, and the start and end times of travel. Furthermore, data on individual and household socio-demographics, individual employment-related characteristics, household auto ownership, and Internet access and usage were also obtained.

Two major efforts were undertaken to conduct the Portland survey. First the four MPO areas were surveyed in 1994-95 with a few extra surveys conducted in Marion, Polk, and Yamhill counties. Eight additional counties scattered across the state were surveyed in 1996. In all, the surveys covered 16 counties and included nearly 15,000 households, among which 11,762 were conducted in 1994 in the first round, and 3,193 in the second round. The total resulting data base includes over 250,000 person trip records. The participating households committed to providing: two day diaries of all activities lasting more than 30 minutes or requiring travel, the location of all of their activities, such as home, work, school, university, shop, recreation, daycare, and other. The survey also collected household demographics, persons, workers, age, income, autos, etc.

Table 2. Data Types Covered in Travel Dairies in Atlanta Household Survey

Types of Activities	Activity Locations	Travel Modes
1 Eating/preparing meals at home/Dining out/Drive thru	1 Home	1 Auto/Van/Truck - Driver
2 Entertainment	2 Work	2 Auto/Van/Truck - Passenger
3 Visit friends/relatives	3 School (Daycare-12th)	3 Transit - MARTA bus
4 Working	4 College/Vocational school	4 Transit - CCT bus
5 Work related business sales call, conference, errand)	5 Already used	5 Heavy rail - Marta
6 School (attending classes)	6 New place	6 Dail-a-ride/paratransit
7 Incidental shopping (groceries, gas, meds)	9 Out of area	7 School bus
8 Major shopping (furniture, clothes, auto, etc)		8 Taxi, shuttle bus, limousine
9 Watching children		9 Motorcycle/moped
10 Household work/Outdoors work		10 Bicycle
11 Fitness/Exercising		11 Walk
12 Outdoor recreation (vacation, camping, sightseeing, etc.)		12 Intercity bus (greyhound, Trailways)
13 Medical/Dental (appointment, treatment, procedure)		13 Airplane
14 Community meetings, political/civic events, public hearing		14 Intercity train (Amtrak)
15 Worship/religious meeting		
16 ATM, banking, post office, bill payment		97 Other
17 Waiting for transportation		
18 Drop off/Pick someone up		
19 Sleep		
21 Rest/Relax		
22 Pick up something/Drop something off		
23 Personal (bath, shower, get dressed)		
24 Personal Business		
25 Volunteer work		
26 Getting Ready		
27 Other at home activities (homework, reading, playing)		
28 Work related from home/doing work from home		

The survey result is presented in three major files, household information, person information, and activity information. The household file contains household physical address and phone number; type, own/rent, years of residence; household size; vehicle information and household income. Personal information includes names of the person, relationship with the household head, gender, age, licensed, employment status/occupation, telecommute, education, ethnic, and disabilities. Finally, the activity file contains detailed information on each activity lasting more than 30 minutes or requiring travel: activity type, place where the activity took place, start and stop times (duration), whether the activity involved a trip, if yes, the trip duration, mode of transportation, vehicle availability, specific vehicle used, pay to park if by car, and number of people in the vehicle.

Southern California Travel and Congestion Survey was conducted in 2001. It is a major survey of travel patterns in the Southern California Association of Governments (SCAG) region. The study occurs once every 10 years to gather detailed information on where people travel, why they travel, and how they travel. However, the data set is unavailable on the internet. Attempts to obtain it from MPO was not successful, thus no further information was obtained.

Another source of data maybe difficult to access due to different data share protocols from different countries and culture. According to Stopher (2006), The Sydney Household Travel Survey (HTS), a continuous survey, collects data on weekend travel, as did the last Adelaide HTS. The Victoria Activity Travel Survey (VATS) also collected data on weekends throughout its duration of a number of years. However, it is not clear whether any weekend model has been built from the weekend data collected there.

4.2 On-Board Transit Surveys

In recent years, there has been a growing awareness of the need to enhance public transit services to relive congestions on the roads. As a result, it has become very important for public transit agencies to carefully evaluate the services so as to provide the more efficient and desirable transit services to the community that it serves. Public transit customer surveys can play an important role in the evaluation of current and planned public transit services. Table 3 presents the most recent transit on board surveys we have access to.

As a regionally focused survey, the Atlantic Regional Council (ARC) On-board Transit Survey was conducted among fixed route riders including both bus and rail in the Metropolitan Atlanta Regional Transit Authority (MARTA), Cobb Community Transit (CCT), Clayton County, and Gwinnett County transit systems. The data collection period began Saturday, October 13, 2001 and continued through Sunday, December 9, 2001. The survey did not include paratransit or demand-responsive service or special event shuttles. It collected origin and destination data, demographic characteristics including household size, vehicle availability, access and egress modes, and public transit use.

Table 3. Transit On Board Surveys

Survey	Survey Date	Sample Size	Weekday	Weekend
Atlantic Regional Council On Board Survey	2001	31,244	25,522	5,722
Hudson Bergen LRT On Board Survey	2005	2,682	Frequency*	Frequency*
River Line Full OD Survey	2004	6,111	3621	2490
PATH Survey	2004	15,850	10922	4928

*Frequency – see Figure1 below

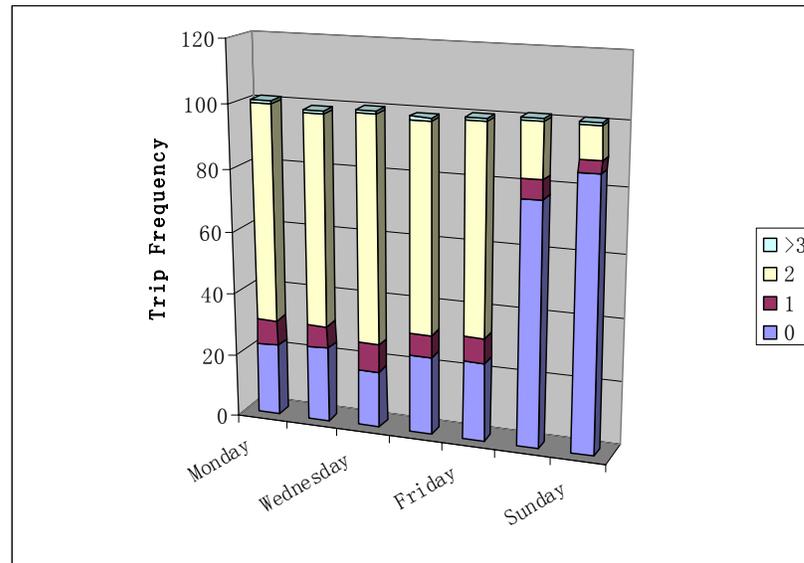
The primary objective of the ARC on board survey is to update input for the regional travel demand models. The transit on-board survey was designed to provide critical information on travel patterns, demographics, transportation options, and mode choice for transit-using residents of the 13-county Atlanta region. The survey has collected information on 25,522 trips during weekday and 5,722 trips during weekend, roughly equating to an 80% and 20% split among weekday and weekend trips respectively. The split of sample size matches the region’s local transit service split.

Interesting findings are highlighted in the survey summary report (ARC, 2002). Similar to other metropolitan areas, public transit in the Atlanta region is mainly used, during the week, for non-discretionary trips, such as work or school, rather than for discretionary trips, such as shopping, social or recreation. Weekend respondents are slightly younger than weekday respondents with 31% weekend and 26% weekday respondents between the ages of 16 and 24.

The Hudson Bergen LRT on board survey was carried out in 2001 and 2005. The 2001 survey consists of 1,213 survey responses and the 2005 survey 2, 682. Information contained in the survey includes on and off board stations, detailed origin and destination locations, access and transfer mode, trip purpose, return trip information, ticket payment method, and service satisfaction rate. The survey does not indicated day of week of each trip, but it asked for the frequency of using Hudson Bergen LRT on a typical day, including weekend.

The majority of the survey respondent, about 70%, uses Hudson Bergen Light rail twice a day on weekday. About 75% of the survey respondents use the facility at least once a day on any typical weekdays. However, most of the survey respondent, 77% on Saturday and 86% on Sunday, does not use the facility during the week at all. Trip frequencies on Hudson Bergen Light rail is the lowest on Sunday, with only 10% of the respondent taking the trip twice.

**Figure 1. Typical One-Way Trip Frequencies
Hudson Bergen Light Rail Transit**



The 2004 River Line Survey, a customer satisfaction survey, was conducted for River LINE in fall 2004 after its launch in March. Altogether 6,111 interviews were collected, with 3,621 weekday interviews and 2,490 weekend interviews. Information collected in this survey include on and off station, connection mode, detailed address of OD, trip purpose, trip frequency, transit fare payment method, number of people traveling, and travel experience on River Line. Demographic information includes age, gender, household income, and race.

2004 PATH survey -- PATH survey was carried out in 1996, 2001, and 2004. The 1996 and 2001 survey questions were distributed at PATH stations and then mailed back to central office. The 2004 survey was a platform-intercepted with passengers interviewed at stations while awaiting trains. The survey form was programmed into a hand-held Palm Personal Digital Assistant (PDA). The main questions asked at each station includes boarding and lightening station, detailed address of OD, access and transfer mode, time of boarding, trip purpose, time of day, and trip frequency. A total of 15, 850 interviews were conducted in 2004 PATH survey, among which 10, 922 contain weekday travel information and 4, 928 contain weekend travel information.

4.3 Other Surveys Conducted In New Jersey

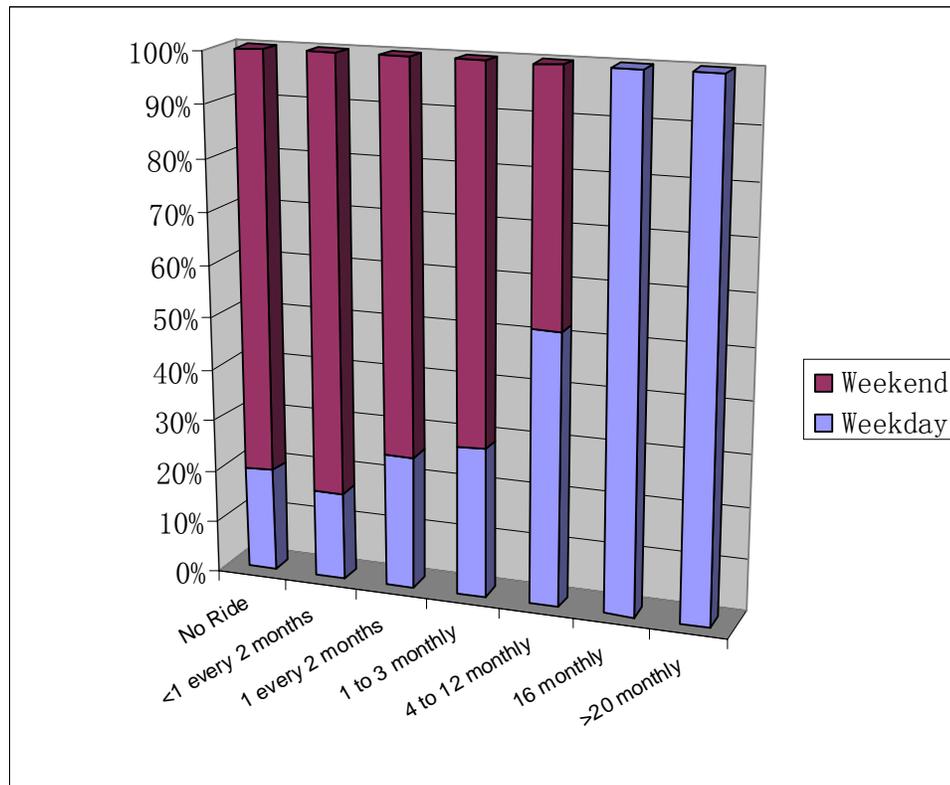
There are two other surveys conducted in New Jersey that may lend some useful data or methodology to this particular study. Both surveys were conducted in 2002 by NJ Transit and both of them address trip frequencies in the survey but via different audiences.

- Rail ePanel Survey 2002
- Interstate Bus Survey 2002

The Rail ePanel survey was launched in 2002 as the internet-based Rail Customer Satisfaction Survey, the most ambitious market-research endeavor in its 23-year history. An independent research firm was hired to handle recruitment and data collection. Patrons were recruited at rail stations and onboard trains. Recruited customers were asked to fill out a brief survey online four times -- once every quarter for a 12-month period. When taking subsequent surveys, participants will be given their responses from the previous survey. Quarterly surveys will allow NJ Transit to track trends, changes and improvements in satisfaction throughout the year. The first wave consists of three panels and 122,471 responses.

Rail transit users were asked to rate their parking experiences, conditions of boarding and destination stations, conditions of trains, schedule, performance during service disruptions, and finally the overall experience with NJ Transit. A list of drill down questions was designed to follow the change of customer's ratings. The rail users were also asked to rate how well NJ Transit handles complaints. The survey also collects information on how frequently the interviewer traveled by NJ Transit rail on weekdays and weekends. The survey also classifies the users as frequent or infrequent weekday or weekend user.

Figure 2. Typical Round Trip Frequencies on NJTRANSIT

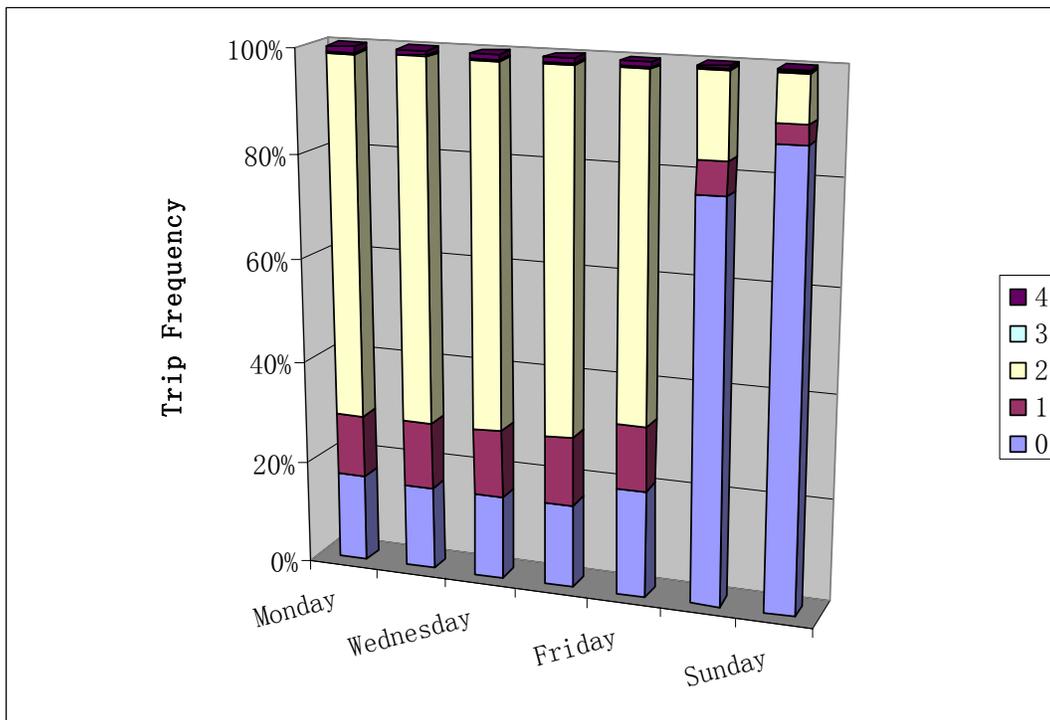


The 2002 Interstate Bus Survey was distributed to bus passengers departing the Port Authority Bus Terminal, Lower Manhattan and the George Washington Bridge bus terminal for an entire day. The survey was distributed to both NJ Transit and private bus operators.

This survey records travel information on origin and destination, boarding and de-boarding station, departure time, connection/transfer mode, bus route, and customer satisfaction rate. Demographic information includes age, gender, language, household size, and number of employees in the household. The survey does not have trip characteristics on weekday and weekend, but has trip frequencies on each day of the week made by the respondents.

Figure 3 presents the result from the interstate bus survey. The majority of the surveyed people, about 70%, take two trips a day by the interstate buses during weekdays. About 85% of the survey respondent will use the bus services at least once everyday during the weekday. However, the majority of the survey respondents on weekend, about 77% on Saturday and 87% on Sunday do not use the bus services at all.

Figure 3. Trip Frequencies by Interstate Bus Survey



5. THE CALGARY APPROACH TO WEEKEND TRAVEL

Calgary is a regional center located in the southern portion of Alberta, Canada. It is the 5th largest metropolitan in terms of population and the 2nd largest in Western Canada, after Vancouver. The City of Calgary comprises roughly 85% of the total population of the larger region (Hunt, et al, 2005a). The urban form of Calgary's development is a concentrated city centre bounded on the north, west and south by a large crescent of low density residential suburbs. A band of industrial land extends along the east side of the city. It has been Calgary's transportation planning strategy since 1960's to utilize each mode including road, transit, walk, and cycling to its best advantages.

Calgary Transit (CT) mainly operates bus routes, 160 in total. However, the backbones of the transit system are two light rail lines. In the past 25 years, the City of Calgary has invested approximately \$1 billion Canadian dollars in developing a three leg, radial LRT system that is closely integrated with an extensive bus network, as shown in Figure 4. Currently, the LRT system consists of approximately 42 km of double track, 116 light rail vehicles and carries more than 220,000 boarding passengers each weekday. The annual ridership has been increasing steadily since the 1980's and reached about 82 million revenue passengers in 2005.

The City of Calgary has recognized the need to estimate the impacts of their travel policy on weekend travel conditions around shopping centers and recreational facilities. It has therefore sponsored the development of a model to forecast travel demand and evaluate travel condition on weekends. The Calgary experience will be a trail blazer in the weekend model development field, which directly related to the objectives of the research presented here.

5.1 Data Collection

The Household Activity Survey (HAS) was conducted in 2001 to collect information on both in-home and out-of-home activities and resulting travel behavior in the Calgary Region. Unlike other household surveys conducted in the U.S, the Calgary survey collected the activity information on one calendar day spreading the data evenly among the seven days of the week by each member of the household. A total of just over 8,400 completed interviews were obtained, among which, a total of 2,342 were assigned Saturday or Sunday. There were 1,394 completed surveys for Saturday and 948 for Sunday.

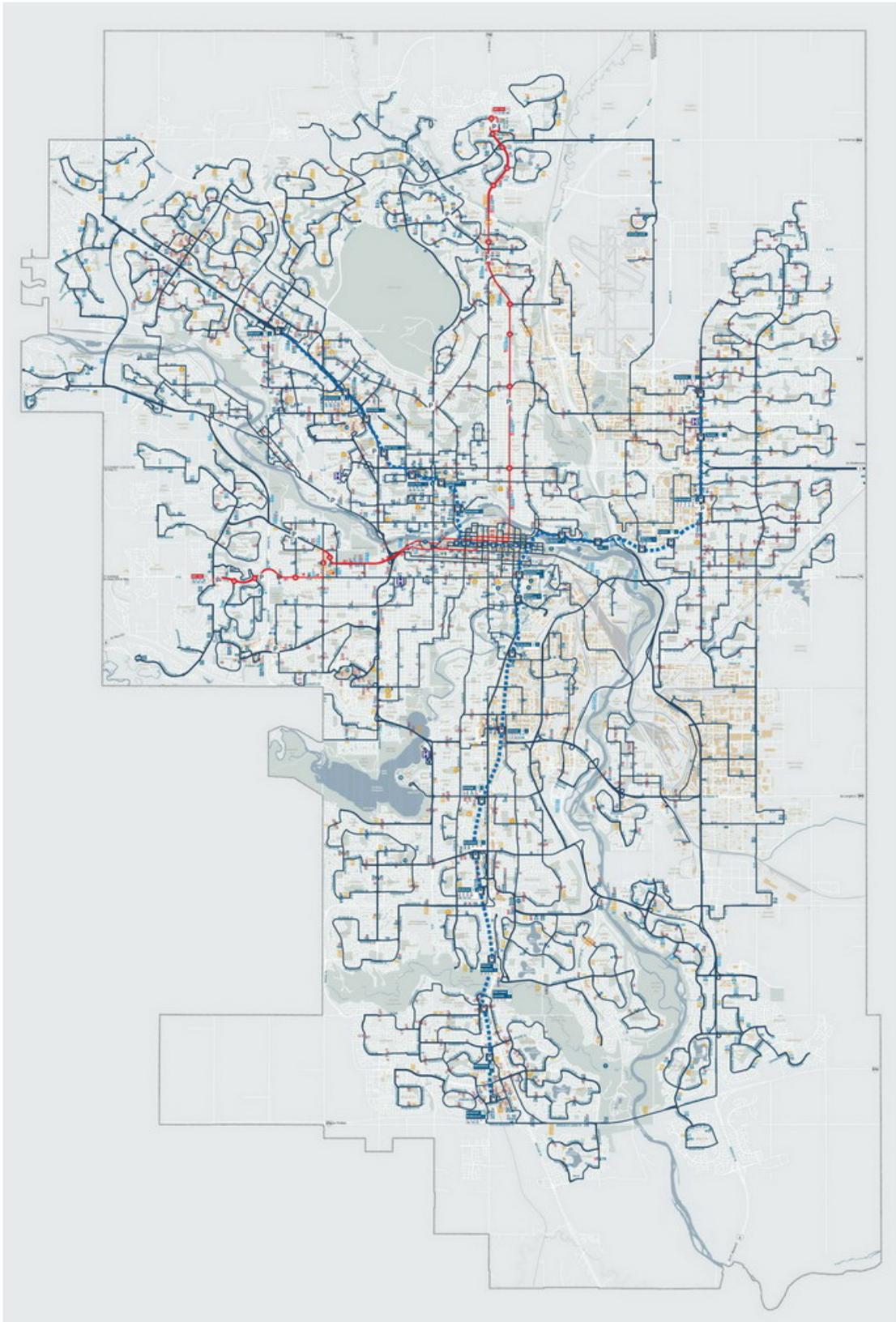


Figure 4. Transportation Network in Calgary

The survey obtained a range of household socioeconomic characteristics, including age, gender, employment and education status of each household member, and the total income and car ownership for the household. The survey also collected information on travel activities over assigned periods using activity diaries and the telephone recovery method.

Similar to an approach used in San Francisco, Calgary surveyed about 0.6% of its total households in the region. The observations of household travel were organized into records of the individual home-based tours made by groups of one or more household members (Hunt, et al 2005b). The result was a sample of 7,644 observations of individual tours containing a total of 19,635 stops made by all sizes of groups.

5.2 Weekend Travel Behaviors

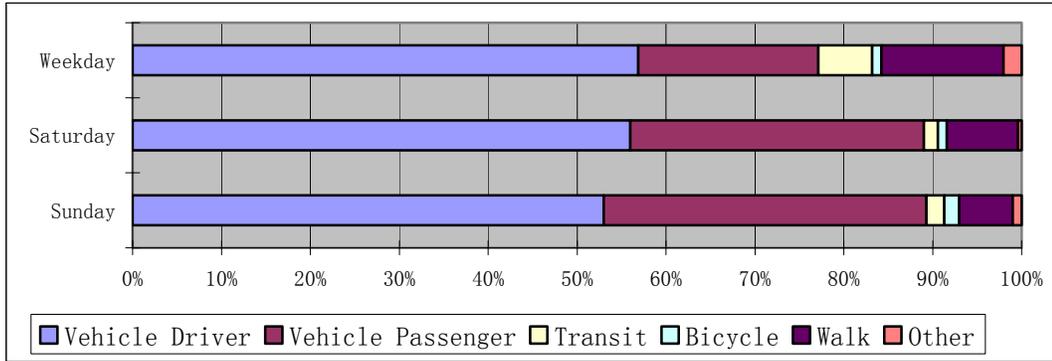
The overall weekend travel pattern is broadly consistent with other weekend patterns described in the literature. As expected, home-based work and home-based school trips rate are much less on weekends. Saturday has the highest of all seven days trip rate, with more home-based shop, home-based recreation trips, and more non-home-based trips. Sunday has lower trip rate than weekdays, but higher trip rate was observed on home-based shop and home-based recreational trips, as shown in Figure 5.



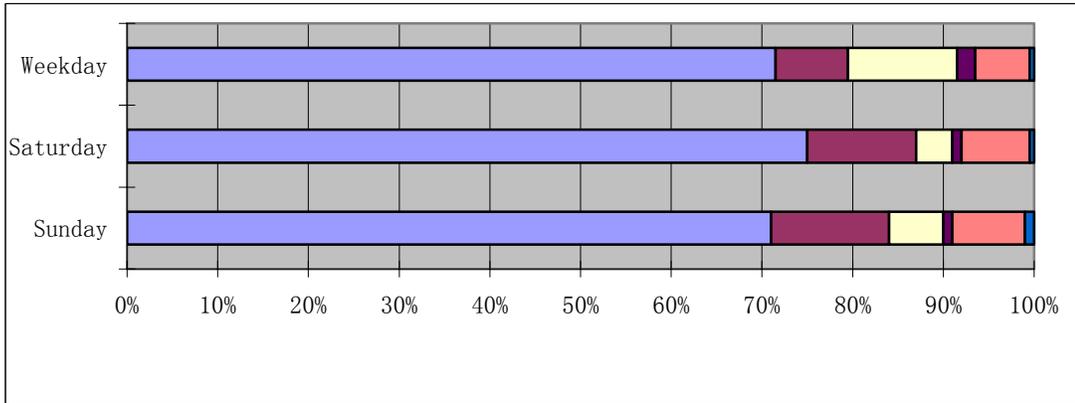
Figure 5. Trip Rates by Trip Purposes in Calgary

As for the mode share for all purposes, more automobile trips were observed on weekends, but with a higher vehicle occupancy rate. It was noted that a higher share of vehicle passengers occur on both Saturday (36%) and Sunday (33%) than on regular weekdays (20%). Transit and walk mode has a lower share on both Saturday and Sunday, as shown in Figure 6A.

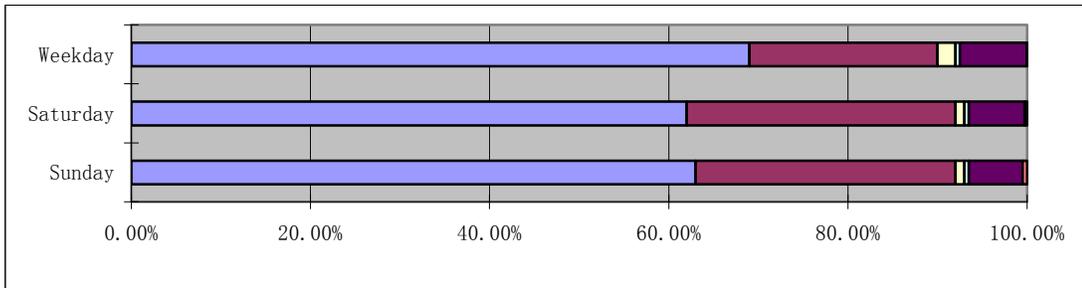
A. Mode share by all purposes



B. Mode share for home based work trips



C. Mode share for home based shopping trips



D. Mode share for social and recreational trips

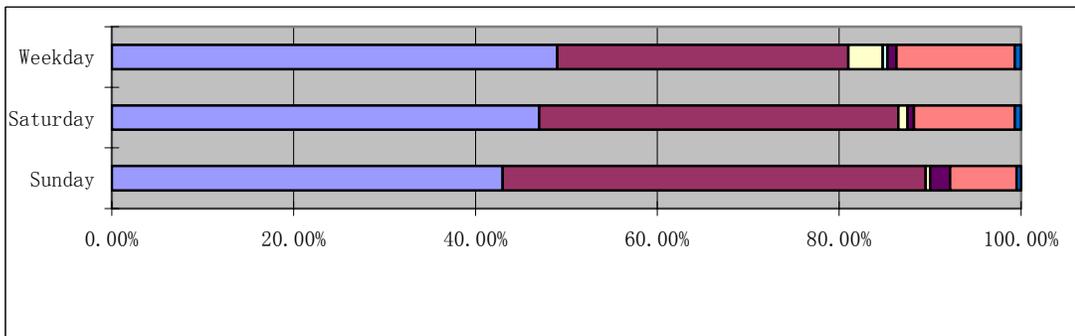


Figure 6. Mode Share by Trip Purposes in Calgary

Furthermore, the mode share pattern varies according to trip purposes as exhibited in Figure 6B, C and D. For example, about 72% of home-based work trips use single occupancy vehicles on weekdays while the portion increased to 75% on Saturdays. On the other hand, the transit use for home based work trip is around 12% during weekdays and drops to just about 6 percent on Saturday and 4 percent on Sundays. This is consistent with observations in other metropolitan areas. The transit shares for shopping trips are small for both weekdays and weekends, around 2 percent and less than 1 percent respectively.

The Calgary activity based survey data included 18 activity categories: sleep, shopping, work, school/homework, religious/civic, volunteer, medical/financial, travel, drop off someone, exercise, entertainment/leisure, social, eating, daycare, out-of-town, household chores, park/unpark vehicles, pick up someone. The 18 categories from the survey were grouped into 11 categories for data analysis. The distributions of the 11 activity categories on weekdays, Saturdays, and Sundays are summarized in Figure 7. It should be noted that the portions are based on stop counts, thus the measurement distribution of trip purposes is based on the activity at the destination and excludes those where home is the destination.

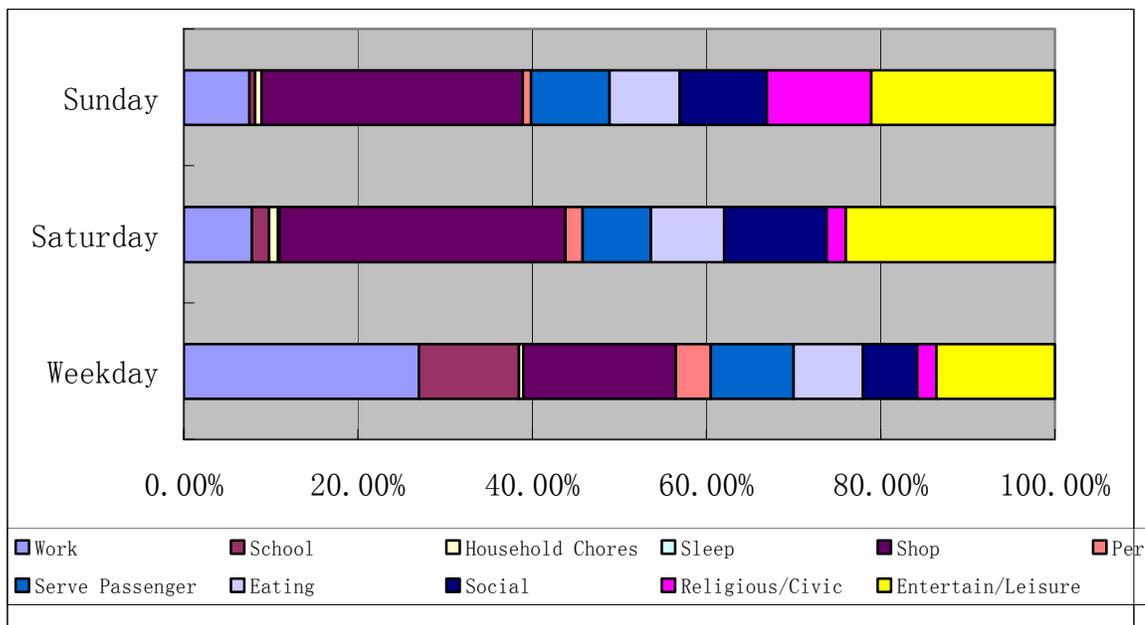


Figure 7. Distribution of Activity Patterns in Calgary

The activity patterns are fairly consistent with observations in other places and intuition. That is, the portion of stops for work and school decrease significantly and the portion of stops for shop, social, and entertainment increase on the weekends. Religious and civil stops increase for Sundays.

The spatial distribution of travel, measured by the start times, is consistent with observations documented in the existing literature. That is, both morning and afternoon peaks are observed on weekdays while only one peak period is apparent on weekends, both Saturday and Sunday, as demonstrated in Figure 8.

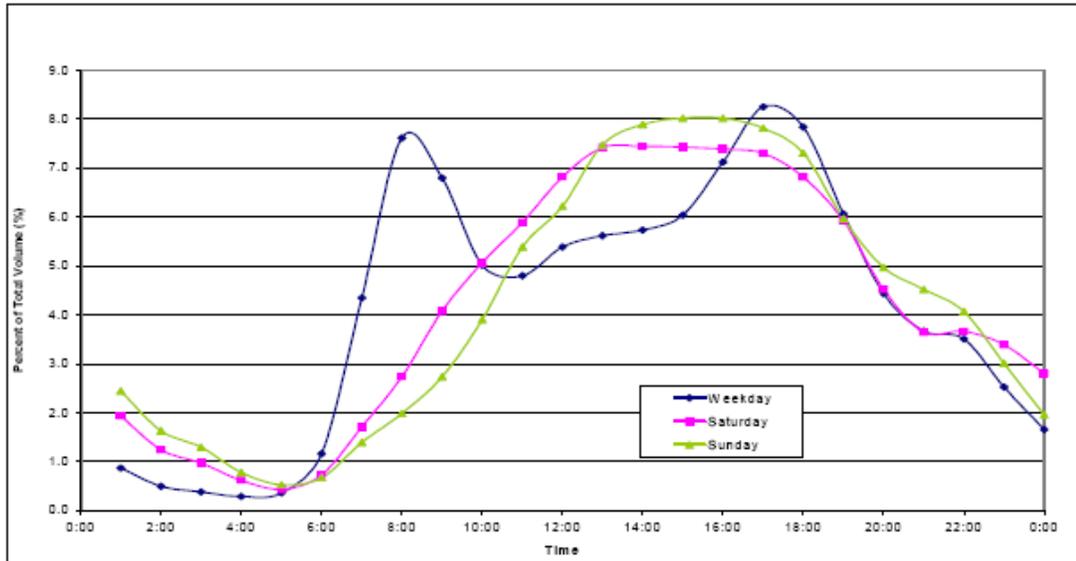


Figure 8. Temporal Traffic Distributions in Calgary
 (Source: Microsimulation Model of Weekend Travel by Households, 2005)

5.3 Modeling Structure

The Calgary Weekend Household Activity Model (WHAM) is a tour-based micro simulation of household weekend travel behavior. A tour is defined as a trip that starts from home and ends at home, which might contain a couple of stops along the way. 18 activity categories collected in the survey were grouped into seven activity categories for modeling purposes. Seven categories used in the modeling are: serve passenger, out-of-town, work, school/homework, religious/civic, exercise, and SELSE (shopping, entertainment/leisure, social, eating). Each observed tour in the sample is designated to be one of these types using a cascading process starting from the beginning of the list. When there are multiple stops with different activities on the tour, the activity on the tour that appears highest in the list dictates the type for the tour.

The final activity types, SELSE, are the most frequent of all of the other out-of-home activities. The reason to include these various activity types into one tour type is because of their similarity in terms of comparatively low degree of fixedness in both time and space and strong tendency to be chained together with other activities. Also, it is difficult to develop any sort of order among these activities that would serve as a basis for the hierarchy of tour types.

The demand for travel arising is micro simulated at the level of each individual household and then aggregated to form zone-to-zone trip tables for assignment to the networks of available transportation services. The output of the tour-based micro simulation is a list of individual tours and the trips within the tours. The Calgary household survey data shows a similar aggregate travel pattern on Saturdays and Sundays, so the assignment of trip tables to network representations is done for a single weekend day, with four assignment periods. The framework is presented in Figure 9.

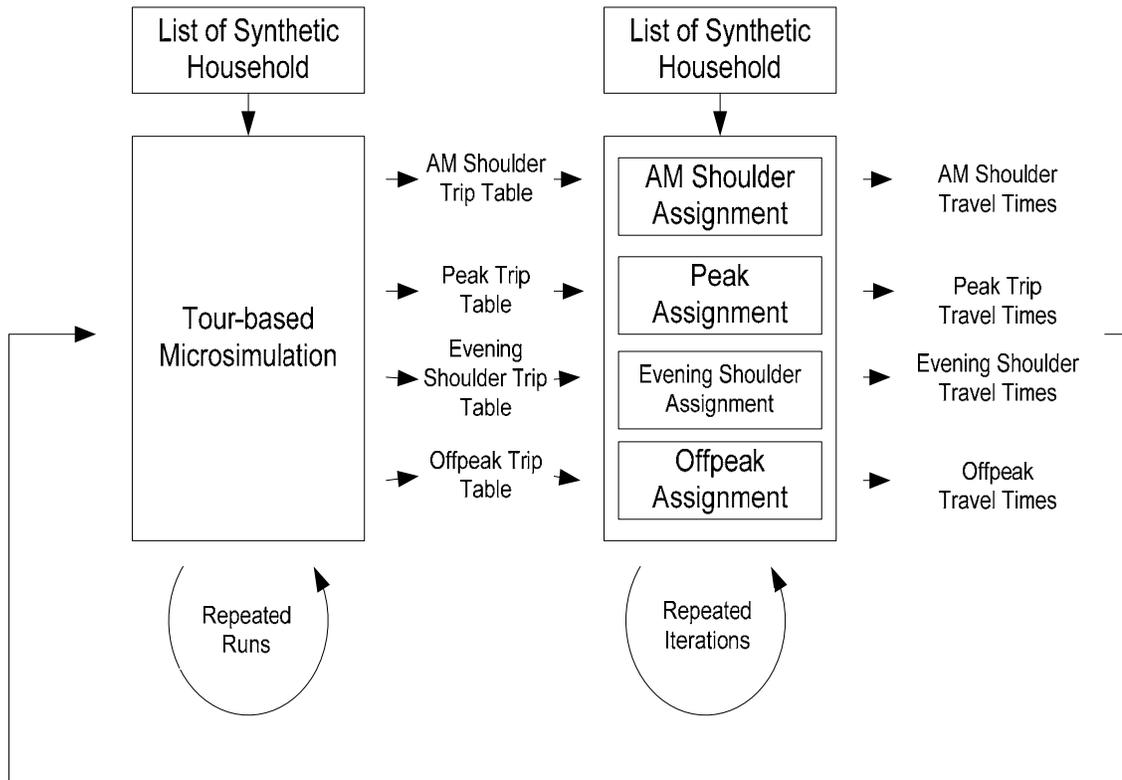


Figure 9. Conceptual framework of Calgary weekend model

5.3.1 Trip Generation

The Calgary weekend model estimated the travel demand for each household using a synthetic household generated from a simulated annealing process. The social economic characteristic of the household and its members are listed in Table 4:

Table 4. Social-Economic Characteristic of Household and individuals

Household	Individual
Income	Gender
Number of autos owned	Age
Hoe location zone	Employment status
Lifecycle category	School status
List of link to household members	Driver status
	Transit Pass Status

Using a tour-based framework, the Calgary weekend model considers individuals starting from and returning to specific homes as one at a time, with the process identifying the attributes of the tour, including:

- The membership the group making the tour,
- The travel mode used for the tour between each stops
- The number of stops and their individual locations
- The start time for the tour and
- The duration for the activity undertaken at each stop.

Monte Carlo techniques are used to identify the attributes of each tour, including both discrete and continuous categories. The travel demand estimates generated from households are then aggregated to form zone-to-zone trip tables. The zonal structure and transportation network is consistent with the traffic analysis zone (TAZ) used in the weekday model in Calgary. This consistency is critical and the MPO staff insisted on it so later integration between those two models will be feasible.

The Calgary weekend model corresponding to the traffic distribution depicted in Figure 8 used four time periods, which is identical to the Calgary weekday model structure. Since the aggregated travel patterns are similar, at the same times on Saturdays and Sundays and they are during reasonably separate times on either day, the four time periods are applied to both Saturday and Sunday.

- AM shoulder: this is the period from 9 AM to 1 PM, which observed moderate traffic volumes, about 29 percent of all weekend trips. The main travel purposes in this period are religious and civic activities.
- Peak: this covers the period from 1 PM to 5 PM, which contains high traffic volumes, about 35 percent of all weekend trips. The predominating purpose of travel during this period is shopping.
- Evening shoulder: this ranges from 5PM to 9 PM, which is occupied by moderate traffic volumes, approximate 22 percent of all weekend trips. The main travel purposes during this period are eating and social activities.

- Off peak: this spans from 9 PM to 9 AM of the following day. This is a period with lowest traffic volumes, about 14 percent of all weekend trips. Activities are low across all purposes.

5.3.2 Activity Duration Model

Hazard/duration models were developed to describe the relationship between activity durations and various influencing factors, such as demographic characteristics, employment status, and income level. The results show high degree of fit, in general, but the “rounding” of reported durations existing in the data result in deteriorated fit and the prediction power of the developed models. It is expected that the developed models could be more accurate if “real” durations had been reported in the data.

A variety of hazard/duration models were specified and analyzed for various activities and demographic groups. The analyzed activities were the same with the travel purposes used in the study. Demographic groups are studied for each type of activity, including AO (adult non-worker), AWNC (adult worker who needs car), AWNNC (adult worker who does not need a car), KEJS (elementary or junior high school students), PSS (post-secondary students), SEN (seniors), SHS (senior high school students), and YO (young other). The analyses were applied to individual activity types and demographic groups to account for the heterogeneity in the data. The models developed in this study explicitly consider many factors of household and individual members, but do not incorporate those by which various policy analyses can be made, such as transit fare and waiting time.

5.5.3 Mode Choice

The Calgary staff is still working on the development of a mode choice model. We were informed that the general approach is based on the characteristics of the available alternatives and the decision-maker in each case, along with an indication of the selection made. The corresponding utility form will be developed based on the estimations of the survey data.

5.5.4 Model Calibration

Once the discrete mode choice model and the continuous duration models are estimated, the microsimulation will then be calibrated to appropriately match various aggregate targets.

An iterative approach will be used and the associated alternative specific constants will be adjusted to improve the match of the output values to specific aggregate targets assessed. The result of Monte Carlo processes will be different with each run, so multiple runs will have to be done and the results will be averaged.

The elements of the microsimulation are interdependent. Adjusting the values of coefficients in one model can alter the output values in other models. The Calgary staff plans to implement an approach in the calibration process where it matches different sets of targets considered consecutively over a series of iterations until the adjustments to the coefficients and the resulting changes in the output values are small enough to be of no consequence. The sets of aggregate targets to be considered include, but not limited to:

- Tour generation by household types, geographic areas, and time periods
- Mode split by household types and time periods
- Distribution of stops by purposes, tour types and time periods
- Number of stops per tour by tour types, etc...

As of this writing, the Calgary weekend model is still in the process of development. The project team will continue our communication with the MPO staff in Calgary to monitor the emergence of the weekend model and report to the Research Project Committee.

SUMMARY

Both MPO and TMIP list server surveys conducted in this task confirmed our anticipation that systematic or general methodology for estimating travel demands, and mode choice in particular, do not exist for weekend travel analysis. The research team have identified potential major special generators during weekend period, especially those that significantly exceed weekday trip generation knowing that weekend travel is dominated by non-work travel as well as very specific peak and off-peak periods quite different from weekdays,.

Travel behavior refers to a number of different choices that people make regarding how they get from one place to another. Primary among these is the total time spent traveling each day; but it also includes the mode used, speed, the total number of trips per day, and whether to travel at all in a given day. A number of household travel survey and transit on board survey data sets are included in this document, which will serve the starting point for the development of weekend travel demand forecast and mode choice models.

As the immediate next step, a model development strategy will be mapped out to incorporate the findings of this task and that from evaluation of existing travel demand models used in New Jersey. A model specification or pilot modeling structure, if possible, will be developed in the next phase of this project.

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APPENDIX 1. QUESTIONS POSTED TO THE TMIP LIST SERVER

From: Liu, Rongfang

Sent: Thursday, April 27, 2006 4:00 PM

To: 'List available for exchange of information relevant to TMIP.'

Cc: Liu, Rongfang

Subject: Weekend Travel

As you may have observed, commuting trips are becoming a declining portion of total travel. Off peak travel, especially on weekends, can often exceed weekday, peak hour volume along certain facilities, therefore; create unanticipated congestions.

I am currently leading a research project by NJDOT to investigate the travel behavior on weekends and explore the feasibility of forecasting travel demand and mode share. To get a current pulse of the modeling community, I would like to pose the following questions:

1. Are you aware of any modeling development by MPO or other agencies that forecast weekend travel? It does not matter whether it is completed or in the various working stages, we would like to communicate with whoever has thought about the issue and put our collective effort together toward a comprehensive approach rather than reinvent the wheel.
2. Have you seen any study that links SE, demographic or other factors to weekend travel, especially those non-commuting travels?
3. Do you know any survey that included weekend travel or activity patterns?

It would be greatly appreciated if you would please share your thought or simply point us in the right direction. I will summarize all the responses and report back to the group if there is interest.

Please feel free to respond to the group or send to my personal email directly. Thank you and look forward to hearing from you.

Rachel

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APPENDIX 2. SURVEY OF METROPOLITAN PLANNING ORGANIZATIONS (MPO)

ID	Metropolitan Planning Organization	State	Major City	Area (Square Miles)	Population	Designation Year	Status
1	Southern California Association of Governments	CA	Los Angeles	38,649	16,516,006	1975	yes
2	New York Metropolitan Transportation Council	NY	New York	2,726	12,068,148	1982	yes
3	Chicago Area Transportation Study	IL	Chicago	4,096	8,150,789	1962	yes
4	Bay Area MPO	CA	Oakland	7,485	6,783,760	1970	
5	North Jersey Transportation Planning Authority	NJ	Newark	4,409	6,310,989	1982	yes
6	National Capital Region Transportation Planning Board	DC	Washington	3,111	4,330,934	1965	
7	Delaware Valley Regional Planning Commission	PA	Philadelphia	3,811	5,387,407	1965	yes
8	San Diego Association of Governments	CA	San Diego	4,260	2,813,833	1972	
9	North Central Texas COG	TX	Arlington	4,969	4,879,204	1974	yes
10	Southwestern Pennsylvania Commission	PA	Pittsburgh	7,110	2,656,007	1974	
11	Southeast Michigan COG	MI	Detroit	4,608	4,833,493	1974	yes
12	Denver Regional COG (email 8/21)	CO	Denver	3,396	2,394,348	1977	
13	Houston-Galveston Area Council	TX	Houston	8,466	4,669,571	1974	yes

14	San Juan MPO	PR	Santurce	1,526	2,363,430	1973	
15	Atlanta Regional Commission (email sent 8/21)	GA	Atlanta	4,573	3,890,582	1971	yes
16	Miami-Dade MPO (email8/21)	FL	Miami	2,015	2,253,362	1977	
17	Puget Sound Regional Council	WA	Seattle	6,384	3,275,847	1991	yes
18	Southeastern Wisconsin Regional Planning Commission	WI	Waukesha	2,684	1,932,908	1961	
19	Maricopa Association of Governments	AZ	Phoenix	9,276	3,112,611	1973	yes
20	Cincinnati-Northern Kentucky MPO	OH	Cincinnati	2,708	1,875,885	1974	
21	Boston MPO	MA	Boston	1,458	3,066,321	1973	yes
22	Broward County MPO	FL	Fort Lauderdale	1,224	1,623,018	1977	
23	Metropolitan Council	MN	St. Paul	2,970	2,642,056	1973	yes
24	Mid-America Regional Council	MO	Kansas City	2,148	1,588,768	1974	
25	Baltimore Regional Transportation Board	MD	Baltimore	2,299	2,512,431	1992	yes
26	Hampton Roads MPO	VA	Chesapeake	2,083	1,530,771	1991	
27	East-West Gateway Coordinating Council	MO	St. Louis	4,586	2,482,935	1973	yes
28	METROPLAN Orlando	FL	Orlando	2,860	1,434,033	1977	
29	Northeast Ohio Area wide Coordinating Agency	OH	Cleveland	2,014	2,148,143	1968	yes

30	San Antonio-Bexar County MPO	TX	San Antonio	1,258	1,392,931	1977	
31	Sacramento Area COG	CA	Sacramento	6,189	1,889,806	1967	yes
32	Regional Transportation Commission of Southern Nevada	NV	Las Vegas	8,089	1,375,765	1983	
33	Metro	OR	Portland	1,019	1,397,042	1979	yes
34	Indianapolis MPO	IN	Indianapolis	1,337	1,299,722	1978	
35	Wasatch Front Regional Council	UT	Salt Lake City	1,798	1,328,388	1973	yes
36	Mid-Ohio Regional Planning Commission	OH	Columbus	1,134	1,239,729	1973	
37	Capital Area MPO	TX	Austin	2,840	1,159,836	1973	yes
38		LA	New Orleans	1,330	1,209,333	1962	
39	First Coast MPO	FL	Jacksonville	1,855	1,063,614	1978	yes
40	Greater Buffalo-Niagara Regional Transportation Council	NY	Buffalo	1,576	1,170,111	1974	
41	Palm Beach County MPO	FL	West Palm Beach	2,002	1,131,184	1978	
42	Nashville Area MPO	TN	Nashville	2,896	1,124,392	1977	
43	State Planning Council	RI	Providence	1,193	1,048,319	1974	

APPENDIX 3. WEEKEND AND WEEKDAY TRIP GENERATION RATE COMPARISON

Land Use	Code	Average Vehicle Trip Ends vs.	Day of Week	Average Rate	Weekend/Weekday
Aviation Airport	22	Acreage flights per day	Saturday	1.98	100.5%
Aviation Airport	22	Based Aircraft	Saturday	3.69	73.8%
Aviation Airport	22	Employees	Saturday	10.96	77.0%
Aviation Airport	22	Acreage flights per day	Sunday	1.87	94.9%
Aviation Airport	22	Based Aircraft	Sunday	4.51	90.2%
Aviation Airport	22	Employees	Sunday	13.28	93.3%
Beach Park	415	Acres	Saturday	66.47	223.0%
Beach Park	415	Acres	Sunday	68.52	229.9%
Business Park	770	1000 Sq. Feet Gross Floor Area	Saturday	2.56	20.1%
Business Park	770	Acres	Saturday	32.61	21.8%
Business Park	770	Employees	Saturday	0.71	17.6%
Business Park	770	1000 Sq. Feet Gross Floor Area	Sunday	1.29	10.1%
Business Park	770	Acres	Sunday	16.78	11.2%
Business Park	770	Employees	Sunday	0.36	8.9%
Cemetery	566	Acres	Saturday	5.94	5.3%
Cemetery	566	Employees	Saturday	112.45	193.6%
Cemetery	566	Acres	Sunday	7.62	6.8%
Cemetery	566	Employees	Sunday	202.45	348.5%
Church	560	1000 Sq. Feet Gross Floor Area	Saturday	9.7	106.5%
Church	560	1000 Sq. Feet Gross Floor Area	Sunday	36.63	402.1%
Commercial Airport	21	Acreage flights per day	Saturday	98.46	94.0%
Commercial Airport	21	Commercial Flights per day	Saturday	113.04	92.5%

Land Use	Code	Average Vehicle Trip Ends vs.	Day of Week	Average Rate	Weekend/Weekday
Commercial Airport	21	Acreage flights per day	Sunday	119.61	114.2%
Commercial Airport	21	Commercial Flights per day	Sunday	137.71	112.7%
Commercial Airport	21	Employees	Sunday	14.7	109.7%
Commercial Airport	21	Employees	Saturday	12.2	91.0%
Daycare Center	565	1000 Sq. Feet Gross Floor Area	Saturday	6.21	7.8%
Daycare Center	565	Employees	Saturday	2.61	8.4%
Daycare Center	565	Students	Saturday	0.39	8.6%
Daycare Center	565	1000 Sq. Feet Gross Floor Area	Sunday	5.83	7.4%
Daycare Center	565	Employees	Sunday	2.45	7.9%
Daycare Center	565	Students	Sunday	0.37	8.2%
General light industrial	110	1000 Sq. Ft gross floor area	Saturday	1.32	18.9%
General light industrial	110	Acres	Saturday	8.73	16.9%
General light industrial	110	Employees	Saturday	0.48	15.9%
General light industrial	110	1000 Sq. Ft gross floor area	Sunday	0.68	9.8%
General light industrial	110	Acres	Sunday	4.42	8.5%
General light industrial	110	Employees	Sunday	0.26	8.6%
High School	530	1000 Sq. Feet Gross Floor Area	Saturday	4.33	32.6%
High School	530	Employees	Saturday	6.65	33.3%
High School	530	Students	Saturday	0.64	35.8%
High School	530	1000 Sq. Feet Gross Floor Area	Sunday	1.72	13.0%
High School	530	Employees	Sunday	2.64	13.2%
High School	530	Students	Sunday	0.25	14.0%
Hospital	610	1000 Sq. Feet Gross Floor Area	Saturday	11.07	66.0%
Hospital	610	beds	Saturday	8.03	68.2%
Hospital	610	Employees	Saturday	3.72	72.0%
Hospital	610	1000 Sq. Feet Gross Floor Area	Sunday	9.91	59.1%

Land Use	Code	Average Vehicle Trip Ends vs.	Day of Week	Average Rate	Weekend/Weekday
Hospital	610	beds	Sunday	7.19	61.1%
Hospital	610	Employees	Sunday	3.34	64.6%
Hotel	310	Employees	Saturday	12.27	85.6%
Hotel	310	Occupied Rooms	Saturday	10.5	117.7%
Hotel	310	Rooms	Saturday	8.19	99.5%
Hotel	310	Employees	Sunday	8.92	62.2%
Hotel	310	Occupied Rooms	Sunday	8.48	95.1%
Hotel	310	Rooms	Sunday	5.95	72.3%
Industrial Park	130	1000 Sq. Ft gross floor area	Saturday	2.49	7.3%
Industrial Park	130	Acres	Saturday	34.23	54.2%
Industrial Park	130	Employees	Saturday	1.14	2.4%
Industrial Park	130	1000 Sq. Ft gross floor area	Sunday	0.73	2.1%
Industrial Park	130	Acres	Sunday	10.11	16.0%
Library	590	1000 Sq. Feet Gross Floor Area	Saturday	46.55	86.2%
Library	590	Employees	Saturday	47.68	97.6%
Library	590	1000 Sq. Feet Gross Floor Area	Sunday	25.49	47.2%
Library	590	Employees	Sunday	23.54	48.2%
Manufacturing	140	1000 Sq. Ft gross floor area	Saturday	1.49	39.0%
Manufacturing	140	Acres	Saturday	33.4	85.9%
Manufacturing	140	Employees	Saturday	0.87	41.4%
Manufacturing	140	1000 Sq. Ft gross floor area	Sunday	0.62	16.2%
Manufacturing	140	Acres	Sunday	13.91	35.8%
Manufacturing	140	Employees	Sunday	0.36	17.1%
Military Base	501	Employees	Saturday	2.64	148.3%
Military Base	501	Employees	Sunday	1.67	93.8%
Motel	320	Employees	Saturday	12.4	119.6%

Land Use	Code	Average Vehicle Trip Ends vs.	Day of Week	Average Rate	Weekend/Weekday
Motel	320	Occupied Rooms	Saturday	8.84	119.6%
Motel	320	Employees	Sunday	10.37	100.0%
Motel	320	Occupied Rooms	Sunday	7.39	100.0%
National Monument	418	Acres	Saturday	8.28	88.2%
National Monument	418	Acres	Sunday	9.39	100.0%
Nursing Home	620	beds	Saturday	2.15	91.1%
Nursing Home	620	Employees	Saturday	3.39	91.1%
Nursing Home	620	Occupied Beds	Saturday	1.52	76.8%
Nursing Home	620	beds	Sunday	2.36	100.0%
Nursing Home	620	Employees	Sunday	3.72	100.0%
Nursing Home	620	Occupied Beds	Sunday	1.98	100.0%
Office Park	750	1000 Sq. Feet Gross Floor Area	Saturday	1.64	14.4%
Office Park	750	Acres	Saturday	29.33	15.0%
Office Park	750	Employees	Saturday	0.56	19.2%
Office Park	750	1000 Sq. Feet Gross Floor Area	Sunday	0.76	6.7%
Office Park	750	Acres	Sunday	13.69	7.0%
Office Park	750	Employees	Sunday	0.26	8.9%
Residential Planning Unit Development	270	Dwelling Units	Saturday	6.82	90.9%
Residential Planning Unit Development	270	Dwelling Units	Sunday	5.09	67.9%
State Park	413	Acres	Saturday	0.61	93.8%
State Park	413	Picnic Sites	Saturday	6.42	64.5%
State Park	413	Acres	Sunday	1.1	169.2%
State Park	413	Picnic Sites	Sunday	14.51	145.8%

Land Use	Code	Average Vehicle Trip Ends vs.	Day of Week	Average Rate	Weekend/Weekday
Truck Terminal	30	Acres	Saturday	17.28	21.1%
Truck Terminal	30	Employees	Saturday	1.47	21.0%
Truck Terminal	30	Acres	Sunday	10.79	13.2%
Truck Terminal	30	Employees	Sunday	0.92	13.2%
University	550	Employees	Saturday	3.12	34.2%
University	550	students	Saturday	1.3	54.6%
warehousing	150	1000 Sq. Feet gross floor area	Saturday	1.22	24.6%
warehousing	150	Acres	Saturday	13.16	23.0%
warehousing	150	Employees	Saturday	1	25.7%
warehousing	150	1000 Sq. Ft gross floor area	Sunday	0.79	15.9%
warehousing	150	Acres	Sunday	0.54	0.9%
warehousing	150	Employees	Sunday	0.65	16.7%