Application of a Travel Demand Microsimulation Model for Equity Analysis

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ABSTRACT

This paper describes the application of a state of the art activity-based travel demand microsimulation model to estimate impacts on mobility and accessibility on different populations to support development of a countywide transportation plan. Equity analyses based on traditional travel demand forecast models are compromised by aggregation biases and data availability limitations. Use of the disaggregate (individual person-level) San Francisco activity-based microsimulation model made it possible to estimate of benefits and impacts to different communities of concern based on individual characteristics such as gender, income, auto availability, and household structure. In this paper, the concepts and policy context of equity analysis in transportation is first presented. Identifying communities of concerns and relevant measures of transportation system performance are then outlined. The San Francisco Model structure is briefly described, and finally, the results of the equity analysis are presented.

INTRODUCTION

This paper describes the application of a state of the art activity-based travel demand microsimulation model to estimate impacts on mobility and accessibility on different populations to support development of a countywide transportation plan. Equity analyses based on traditional travel demand forecast models are compromised by aggregation biases and data availability limitations. Use of the disaggregate (individual person-level) San Francisco activity-based microsimulation model made it possible to estimate of benefits and impacts to different communities of concern based on individual characteristics such as gender, income, auto availability, and household structure. In this paper, the concepts and policy context of equity analysis in transportation is first presented. Identifying communities of concerns and relevant measures of transportation system performance are then outlined. The San Francisco Model structure is briefly described, and finally, the results of the equity analysis are presented.

EQUITY ANALYSIS CONCEPTS

Title VI of the 1964 Civil Rights Act states that, “No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity received Federal financial assistance.” The Civil Rights Act bars not only intentional discrimination, but also bars unjustified disparate impacts, meaning that if a given decision leads to unequal treatment or impacts, even if this unequal treatment is not intended, it is prohibited. Given the vast amount of public resources expended on transportation system improvements, and the significant share of these resources that comes from Federal sources, it is critical to evaluate the potential impacts of transportation policies and improvements on different segments of the population.

In recent years, the Federal government has recognized the importance of the consideration of equity in transportation planning and has issued numerous orders and memos requiring that state and metropolitan transportation planning agencies begin to incorporate “equity-based” analyses in their planning processes. These analyses seek to ensure the inclusion of minority and low-income communities in the transportation planning process, and to ensure that these communities enjoy the benefits of transportation system improvements without disproportionately shouldering the burden of these improvements. However, the Federal government has not issued any specific planning guidelines as to how to perform an equity-based analysis, leaving it up to states, Metropolitan Planning Organizations (MPOs) and other local agencies to decide appropriate means of assessing impacts. In order to perform any equity-based analysis of transportation plan impacts, local governments need to address two key questions: “What communities or people should the analysis consider?” and “What constitutes equity?”

Much of the analysis of the San Francisco Countywide Transportation plan is based on indicators and thresholds established by the Metropolitan Transportation Commission (MTC) (the regional MPO in the San Francisco Bay Area) and it’s Environmental Justice Advisory Group (EJAG) as reported in the “Environmental Justice Report for the 2001 Regional Transportation Plan for the San Francisco Bay Area.” This group worked to define low-income and minority areas for the purpose of evaluating the effects of the Regional Transportation Plan (RTP) on those communities.

IDENTIFYING COMMUNITIES OF CONCERN

Title VI explicitly prohibits discrimination on the basis of race, color and national origin. Many transportation planners have also incorporated income-based analyses to evaluate the impacts of policies and improvements on the poor. In addition, it may also be useful to consider the impacts of policies or improvements on other communities, such as people who are members of households without access to cars. Given the broad range of potential communities for which planners may want to perform equity analyses, it becomes crucial to select the specific communities and establish thresholds to distinguish these communities from the population at large.

The robustness of the analysis is significantly determined by the detail with which the communities of concern can be distinguished. The level of detail is primarily influenced by aggregation issues and data availability limitations. Regarding aggregation issues, many equity analyses based on travel demand forecast models are compromised by the fact that these models operate at an aggregate geographic level (travel analysis zones or TAZs) which may not precisely reflect the communities of concern. For example, although a given zone may be comprised of a majority of low-income households, there may still be many households in the zone that are not low-income. If an aggregate, zone-based travel demand model is being used to support the equity analysis, the presence of not low-income households in the calculations diminishes the validity of the analysis. Regarding data availability limitations, there may be no detailed information on the characteristics related to the communities of concern, making it difficult to distinguish this community from the general population.

In order to address aggregation issues, it is often necessary to establish a set of rules to associate communities of concern with particular travel analysis zones. This approach was used by MTC to support the equity analysis developed as part of the 2001 Bay Area regional transportation plan. For this analysis, zones were classified based on the concentrations of target populations within each zone. After considerable analysis of alternative definitions of target zones, it was concluded that a travel analysis zone with a "minority population of 70% or more, would have a "meaningfully greater" concentration of minority residents and should be included in the analysis" as a minority zone (MTC, p3-4). To assess equity impacts, the effects of transportation plan improvements were then compared for minority and non-minority zones. Such an analysis is not sensitive to or reflective of the fact that significant minority populations may exist in zones not classified as minority (that is, where minority population is less than 70% of total zone population).

The San Francisco County Transportation Authority has applied its state-of-the-art travel San Francisco travel demand forecast model to overcome some of the limitations imposed by more traditional travel demand models, and to provide detailed information on equity impacts that have previously been unavailable. The San Francisco Model uses a "disaggregate" structure, meaning that it estimates travel for each individual San Francisco resident. This structure makes it possible to extract detailed, individual-level statistics on travel based on income, ethnic/racial categories, and levels of car availability. This disaggregate approach is superior to a zone-based approach because it overcomes the effects of the heterogeneity of the population and the lack of detailed data described above. There are, however, limitations. Analyses can only be performed using the attributes that are available at the individual-level or household-level. In the case of the San Francisco travel demand model, these individual and household characteristics are derived from the Census Public Use Microsample (PUMS) data used to create a synthetic population, or are produced endogenously by other San Francisco model components.

For the San Francisco Countywide Plan equity analysis, the Transportation Authority considered many different types of communities within San Francisco based on vehicle availability (0-vehicles), income (low-income), household structure (female headed households with children, single parent households), and gender.

The vehicle availability equity analysis was simply based on whether a given household (and by extension members of that household), had access to a vehicle.

The income equity analysis considered low-income households. The definition of the low-income community was based on the threshold defined by MTC in its "2001 RTP Equity Analysis and Environmental Justice Report." This report proposed that the threshold for low-income should be defined as 200% of the Federal Department of Health and Human Services poverty line, due to the high cost of living in the Bay Area. In MTC's analysis, zones where 30% of the total population or greater is low-income were identified as low income. An additional advantage of the using the disaggregate San Francisco Model approach is that the low-income status of each household can incorporate information about both the households size and the household income. Table 1 shows the thresholds used to identify whether a household (and members of that households) are considered to be low-income.

The racial/ethic equity analysis was not included in the Plan due to the unavailability of data on non-white Hispanics in the model's synthesized population. This is an area where further model development and enhancement is necessary.

IDENTIFYING INDICATORS OF TRANSPORTATION SYSTEM EQUITY

Once the communities of concern have been determined, it is necessary to identify the indicators of transportation system performance and equity. For the Countywide Plan equity analysis, the Transportation Authority considered two commonly used primary indicators of transportation system performance: mobility and accessibility.

Mobility reflects the ease of moving throughout the transportation system. The primary measure of this is the travel time or speed of trips. To compare the mobility benefits of the plan alternatives, the Transportation Authority coded the transportation system improvements associated with each alternative, and then ran the full San Francisco Model set to forecast the effects of these improvements on San Franciscans' travel. These results were then analyzed to calculate the changes in time spent traveling by different portions of the populations. For example, for a baseline and build alternative, the Transportation Authority calculated the total travel time, the transit travel time, and the transit mode share for members of 0-vehicle households as well as for members of households with more than 0 vehicles. This analysis was carried out for 0-vehicle households, low-income households, single-parent households, female residents and female-headed households.

The Transportation Authority also considered accessibility. Accessibility is the ability to reach desired destinations within a reasonable amount of time, and is intended to reflect origin-destination connectivity as well as land use. Two simple means of determining accessibility are to consider accessibility to jobs and accessibility to shopping. The Transportation Authority evaluated accessibility to jobs in the AM peak by auto and by transit, and accessibility to shopping opportunities (as represented by retail employment) in the PM peak by auto and transit. For example, the accessibility analysis considered the number of jobs accessible within 30 minutes in the AM by auto and by transit from the zone in which the individual person resides. The equity measures used by the Transportation Authority were based on those developed by MTC in their Environmental Justice Plan, though these measures were applied by MTC in an aggregate zonal framework.

In the Environmental Justice Plan, MTC assessed the mobility and accessibility impacts of the proposed RTP investment plan through three travel model-based evaluation factors:

1. Accessibility to Jobs – The number and percentage of all regional jobs accessible within 15, 30, and 45 minutes of the identified minority and low-income communities compared to the rest of the Bay Area by automobile and by transit. (the 15 minute range was later determined not to be a good measure for comparison sake)
2. Travel Time – Aggregate travel time and average travel time for work and non-work trips by transit and by automobile for the identified minority and low-income communities compared to the rest of the Bay Area.
3. Transit Travel Time to Major Job Centers – Travel times by transit from the identified minority and low-income communities to selected job centers.

(MTC. September 2001. p4-2).

The MTC equity analysis considered whether "the low-income and minority communities have levels of accessibility and mobility in the RTP that are at least comparable to those for the rest of the Bay Area and whether these communities experience increases (or decreases) that are comparable to those experienced for the rest of the Bay Area,"(MTC, September 2001. p4-3)

DEMOGRAPHIC TRENDS

Some of the expected changes between 2000 and 2025 in the communities of concern that the Transportation Authority has identified are summarized here.

The 2000 Census indicated that 11.3% of San Francisco households are below the poverty level. Because for this analysis we used a low-income threshold derived from the regional transportation commission (MTC), 200% of HHS poverty, the share the San Francisco population from low-income households in this analysis in 2000 is slightly higher at 14.5%. The number and share of low-income households is expected to decline significantly between 2000 and 2025. By 2025, it is expected that only 9.7% of people will be members of low-income households.

The 2000 Census indicated that 28.5 % of San Francisco households are 0-vehicle households, which is consistent with the SF Model estimate of 29.6% of San Francisco households having 0 vehicles. The share of the total population of San Francisco residents that are members of 0-vehicle households in 2000 is lower (21%) than the share of 0-vehicle households, due to the fact that it is often smaller households that are 0-vehicle households. The population of San Francisco residents that are members of 0-vehicle households in 2025 declines only slightly to 20%. While the number and share of people living in higher-income households is expected to grow between 2000 and 2025, the number of people from households that choose not to have an automobile is expected to remain essentially constant. This is notable because it is counter to the typical trend, where higher incomes lead to higher overall levels of auto ownership.

ACTIVITY BASED MICROSIMULATION MODELING AND EQUITY ANALYSIS

Congestion Management Agencies (CMA) in California are required to maintain a countywide transportation computer model. The Transportation Authority is the CMA for San Francisco County and in this capacity maintains the San Francisco travel demand forecast model, as well as a GIS database for the graphic display of model outputs and more detailed spatial analysis. The Authority uses these tools for sketch planning and the policy-level travel demand and performance forecasting exercises associated with long range planning, including equity analysis of long range plans, as described here.

The SF Model is used to assess the impacts of land use, socioeconomic, and transportation system changes on the performance of the transportation system. The SF Model uses San Francisco residents' observed travel patterns, detailed representations of San Francisco's transportation system, population and employment characteristics, and transit line boardings during specific time periods, roadway volumes, and the number of vehicles available to San Francisco households to measure performance. Future year transportation, land use, and socioeconomic inputs are used to forecast future travel demand.

While the San Francisco Model represents one of the most sophisticated models in use currently and has greater capabilities than most other models, it is still limited in its sensitivity. There may be benefits associated with transportation policies or improvements that the model cannot indicate.

One of the primary goals in adopting the approach of the San Francisco Model was to have the ability to specifically analyze the impacts of policies and improvements on different segments of the population. This is accomplished by estimating the travel patterns of individual San Francisco residents, including when they travel, where they are coming from and where they are going to, the mode of transportation they are likely to use, and even the specific routes they are likely to use. For the purposes of the Countywide Transportation Plan, only the transportation system inputs vary by alternative. Land use and demographic assumptions remain constant. The addition of new transit or roadway improvements will alter the travel patterns of some travelers, and thus the mobility and accessibility measures identified will be affected as a result of these changes.

THE SAN FRANCISCO MODEL

The model is applied as a "windowed" model, which combines trip making from the entire San Francisco Bay Area with the travel demand from San Francisco residents produced by the activity-based model. All trips made by San Francisco residents within San Francisco are estimated from the activity-based models. Trips that do not begin and end in San Francisco are taken from a regional model maintained by the regional metropolitan planning organization (MTC) model and are applied to the San Francisco Model networks, which include the entire Bay Area.

Although the San Francisco Model predicts the behavior of individual San Francisco residents, the model also uses a zone system to maintain land use and socioeconomic inputs, to represent travel times and costs between areas, and to perform roadway and transit network assignment. The model's zones are approximately equivalent to Census block groups, ranging in size from a single block in the dense urban core, to groups of six to ten blocks in less densely developed residential area on the City's west side.

Figure 1 illustrates the San Francisco Model structure. The following sections briefly describe the individual model components.

SYNTHETIC SAMPLE GENERATOR

This program generates a full synthetic population of San Francisco residents for a base year or forecast year. Households are categorized simultaneously by household size/workers (9 groups), age of head of household (3 groups) and income class (four groups). Sample enumeration is not used in the SF Model.

WORKPLACE LOCATION MODEL

For each worker in the synthetic sample, a workplace zone is drawn from forty sampled zones according to multinomial logit model probabilities based on worker characteristics, mode choice accessibility logsums from work tour mode choice and work zone attributes. The number of workers is constrained to match employment by TAZ through the implementation of a shadow pricing mechanism which is run to close within a reasonable tolerance.

VEHICLE AVAILABILITY MODEL

For each synthetic household, 0, 1, 2, or 3+ autos is chosen according to multinomial logit probabilities based on the characteristics of the household.

FULL-DAY TOUR AND TRIP PATTERN

For each synthetic person, the probability of each full-day pattern (comprised of tours and trips), including "no travel," is predicted for each person. A random Monte Carlo procedure is used to select a single pattern. The main feature of the "full-day pattern" approach is that it simultaneously predicts the main components of all of a person's travel across the day.

TIME-OF-DAY MODELS

The Time of Day Models predict the period when the traveler leaves home to begin the primary tour, simultaneously with the period when the traveler leaves the primary destination to return home. The periods used are early AM, AM peak, midday, PM peak, and evening.

TOUR PRIMARY DESTINATION AND MODE CHOICE MODELS

The mode choice models developed for the SFCTA Model determine the mode for tours, and also for all trips made as part of tours, and are the basis for the accessibility measure (logsum) used in the tour primary destination choice models. The mode choice models differ from traditional "trip-based" mode choice models in that there are two distinct sets of mode choice models. The tour mode choice model determines the primary mode for the tour, while the trip mode choice models determine the mode for each individual trip made on that tour, based on the mode chosen for the tour.

INTERMEDIATE STOP LOCATION CHOICE

The intermediate stop location choice model chooses a TAZ for every stop on each tour. Intermediate stops are defined as activity locations that are between the tour anchor location (home or work) and the tour primary destination. For each intermediate stop on each tour, an intermediate stop zone is chosen from forty sampled zones according to multinomial logit probabilities based on characteristics of the person and tour, zone size, and the additional cost of travel between the tour origin and destination imposed by the sampled stop. The cost of travel for each intermediate stop location is based on highway time. Random numbers are used to control the selection of the sampled zones and the selection of an intermediate stop.

TRIP MODE CHOICE

For each tour, a mode is chosen from eleven possible modes (Figure 2) according to logit probabilities based on characteristics of the person and tour and levels of service between the trip origin and destination zone conditioned by the chosen tour mode. A random number is used to select the chosen mode.

ASSIGNMENT

This time period-specific demand is then assigned to the regional roadway and transit networks. The Transit Assignment Model predicts the specific route chosen, and any transfers, based on walking time to the nearest stop, expected wait time, presence of other transit alternatives (such as the multiple routes that serve a significant portion of Van Ness Avenue), fares, in-vehicle travel time, and walk time to the final destination.

Roadway assignment predicts the specific route chosen by travelers based primarily on congested travel times. If a particular route between two points is faster than another, it will attract drivers until the travel time on all routes between two points is equal.

EQUITY ANALYSIS RESULTS

The Transportation Authority's Countywide Transportation Plan included explicit equity objectives to be advanced deliberately through the implementation of specific transportation policies and projects. The Plan called to "ensure equity in transportation investments through a broad distribution of benefits among all city residents; minimizing the negative impacts of transportation investments; and encouraging appropriate pricing of strategies to promote efficient use of the system." The objectives were identified with the support and participation of stakeholders in the plan development process, and were intended to be sensitive to both the characteristics of projects under consideration, as well as sensitive to the distribution of plan impacts, both geographically and within San Francisco's various communities. The Countywide Plan specifically targets areas and communities of historic underinvestment, such as the Third Street Corridor, the Bayveiw/Hunter's Point neighborhood and south county areas. In addition, the also includes a citywide Bus Rapid Transit network which is intended to enhance overall transit network connectivity.

In order to assess the effectiveness of these investments, and the distribution of benefits, of the overall Plan, the Authority analyzed the mobility and accessibility benefits under the Plan for five important communities of concern:

- population in zero-vehicle HHs vs. population in not zero-vehicle HHs
- population in low-income HHs vs. population in not low-income HHs
- population in female-headed HHs with children vs. population in not female-headed HHs with children (status based on head of householder identified as female, and presence of HH members less than 18 years old (note this is *not* single female-headed HHs with children)
- population in single-parent HHs vs. population in not single-parent HHs (single parent status based on no spouse identified in HH, and presence of HH members less than 18 years old)
- population male vs. population female

MOBILITY

Three measures of mobility were used in this analysis:

- average daily travel time savings in minutes;
- average daily transit trip travel time savings in minutes;
- change in transit mode share for all trips.

Table 2 shows the results for these measures for the five identified communities of concern. These measures are based on a comparison of a baseline alternative to a build alternative for the year 2025. It should be noted that the baseline alternative already assumes a significant number of major transportation improvements in the county, such as the Caltrain downtown extension to a rebuilt Transbay Terminal, and completion of the 3rd St. Light Rail Phase 2 (Central Subway). The benefits that might result from those baseline projects are not reflected in this analysis, though they would almost certainly accrue to the communities of concern. The build alternative contains a limited number of additional major transit improvements.

The average total daily travel time savings in minutes is estimated by summing for each individual the travel time spent in the baseline alternative and spent in the build alternative, reflective of the mode selected for each trip. The difference between these total travel times is calculated and averaged across individuals. This measure is intended to reflect the overall improvement in travel time for the population of concern.

The average daily transit trip travel time savings is estimated in the same way as the total daily travel time savings, but includes only those trips which occur on transit. This measure is intended to reflect the actual level of transit travel time improvement experienced by individual transit travelers as a result of the implementation of plan projects.

The change in transit mode share is calculated by dividing the total transit trips by the total trips by all modes. The change in transit mode share is intended to reflect the success in attracting population or community trips to transit.

Overall, the results show a slight travel time reduction across the entire population of San Francisco residents of 0.11 minutes. All three measures described above were calculated for each community of concern, as well as the population not in the community of concern. For example, the total travel time of people who are members of 0-vehicle households declines by 0.37 minutes, while the total travel time of people who are members of households with at least one vehicle declines by only 0.06 minutes, indicating that members of 0-vehicle households generally receive more of the plan benefits than members of households with more vehicles. This may reflect the fact that 0-vehicle households are generally located in more transit-rich areas, and that the build alternative includes significant transit improvements. The increase in the transit mode share for 0-vehicle households is noticeably greater than for households with at least one vehicle, though the average transit travel time savings is marginally lower for members of 0-vehicle households.

The members of low-income households experience very slightly greater travel time savings than people who are not members of low-income households. However, the change in transit mode share for low-income households is very similar to the change in transit mode shares for members of non-low-income households, indicating that the plan improvements are no more or less successful in attracting members of low-income households than in attracting people who are not members of these households.

The members of female-headed households with children experience virtually no improvement in their average daily travel time. This may be due to the relatively fixed nature of some household destinations such as schools, which in the San Francisco Model can influence the tripmaking and mode choice patterns of both the parent and the children. The members of single parent households experience virtually the same effect as the female-headed households with children, likely due to the significant overlap between these two communities.

Finally, the analysis considered the differences experienced by women and men, and found that these differences were insignificant (less than 0.03 minute difference in overall daily travel time).

ACCESSIBILITY

Four measures of accessibility were used in this analysis:

- % change in job access by auto;
- % change in job access by transit;
- % change in shopping access by auto;
- % change in shopping access by transit

Table 3 shows the results for these measures for the five identified communities of concern.

The % change in job access by auto is estimated by first calculating at a zonal level the number of jobs accessible by auto within 30 minutes in the AM peak in both the baseline and the build alternatives, then associating these totals with each individual based on the individual's residence zone, and finally calculating the percent difference. The % change in job access by transit is estimated the same way, but is based on the number of jobs accessible by transit within 30 minutes in the AM peak. The % change in shopping access by auto is estimated by calculating the number of retail jobs accessible by auto within 15 minutes in the PM peak. The % change in shopping access by transit is estimated by calculating the number of retail jobs access by transit within 15 minutes in the PM peak.

The results show a similar pattern across all communities of concern as well as the overall population. Access to jobs by auto declines slightly, due to slightly increase congestion associated with the reduction in overall roadway capacity due to transfers of right-of-way to transit. On the other hand, access to jobs by transit increases noticeably across all population segments, due to the transit improvements associated with the build alternative. Access to shopping opportunities (as represented by access to retail employment) shows a similar pattern – access to shopping by auto declines slightly, while access to shopping by transit increases noticeably. There is some variation across the communities of concern – for example, the increase in access to jobs by transit for members of 0-vehicle households and low income households is lower than for the other segments, but this is likely due the fact that these households are generally located in areas already well-served by transit.

CONCLUSIONS

This paper demonstrates disaggregate activity-based travel demand forecast models can overcome a number of critical limitations of travel demand models and lead to more robust and detailed equity analyses. Specifically, disaggregate travel models can provide more detail with which to distinguish communities of concern, and can overcome the aggregation biases of traditional zone-based travel models.

The San Francisco County Transportation Authority applied the disaggregate San Francisco Model to compare benefits among communities of concern with the goal of improving the Countywide Plan's ability to ensure commensurate benefit levels for these groups. The results indicated areas for further consideration and development among policymakers and planners. Among these are improved service planning for target communities and land use coordination to increase transit attractiveness, such as encouraging childcare services to locate near transit. In addition to identifying areas for further policy consideration, this analysis has also helped identify further model enhancements, such as including all relevant Census racial/ethnic data in the synthesized population to support detailed equity analyses for different communities, and expanding the performance measures to address bicycle and walking modes.

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List of Tables and Figures

Table 1. 2000 Health & Human Service Poverty Guidelines (converted to 1990$)

Household size	Guideline	200%
1	6,338	12,675
2	8,539	17,078
3	10,740	21,480
4	12,941	25,882
5	15,142	30,284
6	17,343	34,686
7	19,544	39,089
8	21,745	43,491
Additional HH member	2,201	4,402

SOURCE: *Federal Register*, Vol. 65, No. 31, February 15, 2000, pp. 7555-7557.

FIGURE 1 San Francisco model components.

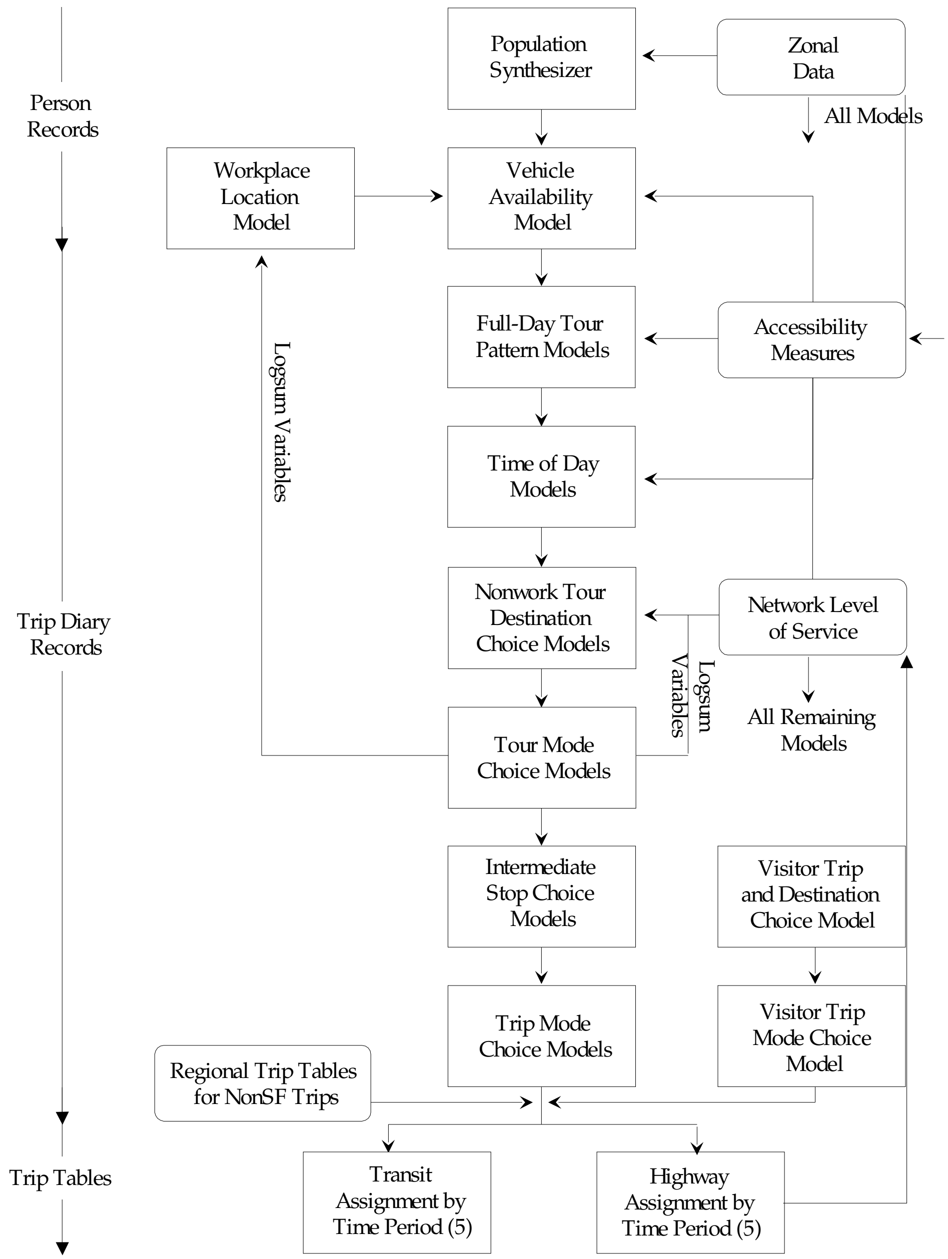

Table 2. Equity Performance Measures of Mobility

TRAVEL TIMES

	Time Savings (avg min)	Transit Time Savings (avg min)	Change Transit Share
All	**0.11**	**1.74**	**0.8%**
Zero Vehicle	**0.37**	**1.69**	1.2%
Not Zero Vehicle	**0.06**	**1.79**	0.7%
Low Income	**0.16**	**1.48**	0.7%
Not Low Income	**0.10**	**1.79**	0.8%
Female Head w/Children	**0.04**	**1.39**	1.1%
Not Female Head w/Children	**0.11**	**1.77**	0.8%
Single Parent	**0.02**	**1.25**	1.0%
Not Single Parent	**0.11**	**1.79**	0.8%
Female	**0.09**	**1.69**	0.8%
Male	**0.12**	**1.78**	0.8%

Table 3. Equity Performance Measures of Accessibility

	% Change Jobs by Auto	% Change Jobs by Transit	% Change Shopping by Auto	% Change Shopping by Transit
All	**-0.3%**	**13.9%**	**-0.7%**	**19.1%**
Zero Vehicle	-0.6%	9.1%	-1.5%	19.1%
Not Zero Vehicle	-0.2%	15.9%	-0.5%	18.5%
Low Income	-0.1%	9.3%	-0.8%	14.1%
Not Low Income	-0.3%	14.6%	-0.6%	20.2%
Female Head w/Children	-0.1%	13.1%	-0.5%	17.1%
Not Female Head w/Children	-0.3%	14.0%	-0.7%	19.3%
Single Parent	0.0%	13.1%	-0.5%	17.0%
Not Single Parent	-0.3%	14.0%	-0.7%	19.3%
Female	-0.3%	14.1%	-0.7%	19.3%
Male	-0.3%	13.8%	-0.6%	18.9%