Review of Alternatives Analysis
Ridership Forecasts

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Overview

Documents related to ridership estimates were reviewed, including the *Honolulu High-Capacity Transit Corridor Alternatives Analysis Report*, the draft Transit Forecasting Methodology Report, and *Travel Forecasting Model Development Project* of the Oahu Metropolitan Planning Organization, Final Documentation. In addition telephone interviews were conducted with Mr. Toru Hamayasu (DTS), Mr. Gordon Lum (OMPO), and Mr. Mark Schiebe (PBQD).

The review was focused on three interrelated questions: 1) are the models and methods used sound? 2) do they produce useful information? and, 3) are the results accurate, reliable, valid? The review concludes with some summary comments.

Background

The Alternatives Analysis provides estimates for 2005 and 2030 for existing conditions, no-build,TSM, Managed Lane, and a number of Fixed Guideway alternatives. The ridership estimates are based on the OMPO regional travel demand model which was updated to estimate the effects of both existing conditions and the various alternatives. OMPO uses a "best practice" modeling approach whereby the components of the traditional four-step (trip generation, trip distribution, mode choice, network assignment) estimation procedure have tested and validated in other jurisdictions and then used in Honolulu. While there have been some new approaches to demand forecasting proposed in the literature, the emphasis with OMPO is to use industry-standard and FTA approved methods and approaches along with updated information. The number of trip assignment zones has been increased from 284 to 762. A new on-board bus survey was completed in 2005 which was used to validate the results of the ridership estimates. Some other enhancements to the OMPO model include the use of 11 different resident trip purpose (including 6 work-related trips) and a two stage trip distribution process to link trip productions to attractions and produce trip tables. The trip distribution procedure uses a Fratar, iterative fitting technique for balancing rows to equal productions and columns to equal attractions. The mode choice model utilizes a nested structure in which auto, transit, and non-motorized travel (walk/bike) are considered; as are options such as single vehicle occupant, 1- and 2- occupant auto, local and premium bus

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services as well as kiss-n-ride and park-n-ride facilities. In addition to the estimation of ridership, travel times by mode and class and type of service are also provided. The FTA SUMMIT package also generates zone-to-zone estimates of ridership and travel benefits and impacts.

Soundness of Methods

After reviewing the various documents and speaking to many of the principals involved, I am convinced that the general approach – that is, using a version of the traditional four-step process, using the same model that was developed for the metropolitan planning organization (OMPO), and following FTA's guidelines and recommended procedures is not only sound, it provides opportunity to take advantage of work done over the years for Oahu as well as to incorporate ideas and knowledge from other jurisdictions. The "best practice" approach may not necessarily lead to the most innovative, or advanced or latest theoretical developments in ridership forecasting, but it does enable the City to build on widely accepted, tested, and used approaches to ridership forecasting. The other advantage is that it enables a degree of peer-review to occur, not just because the OMPO models have been developed and tested and reviewed and vetted over a 10 year period, but also because FTA has reviewed and accepted both the model form and the use of various parameters and functions used in the modeling process.

There has been discussion as to whether or not the traditional four-step, "comprehensive" approach should have been used. It is the industry standard. It is what is currently taught as the approach to take in urban transportation planning courses. The advantage is that the pieces of the model can be disentangled – from the land use and population projections, to auto ownership, to the generation of trip (work, school, recreational, etc.), to the distribution of trips in terms of origins and destinations and in terms of production and attraction zones, to the modal split (between transit and private automobile) including various nested combinations (park-n-ride, kiss-n-ride, bus-to-rail, etc.), as well as non-motorized modes (walk and bike). While the approach is complicated and multi-faceted, the value of it is that it lets us review, systematically, the various assumptions, data, forecasts, and inputs into the model and it allows us to understand both the overall ridership estimates as well as the regional, neighborhood, and eventually station location effects. While there have been some general criticisms of the large-scale comprehensive modeling it is, fundamentally, a sound approach to ridership estimation.

There have been some notable improvements made to the forecasting procedures used in Honolulu. The number of trip assignment zones (TAZs) has been greatly increased. The kinds of different trip purposes has also been augmented. There have been continued developments in the trip distribution procedures. The model uses a Fratar approach which provides a form of internal consistency and validation, as the trip tables must balance. It is the recommended approach for the trip distribution component of the model. It should also be noted that there

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have been improvements in the mode choice part of the estimation procedure. A nested logit multinomial model is generally acknowledged as the preferred approach. While we are somewhat constrained by the choice of nests and the particular ordering, it does provide a superior approach to considering different travel modes in a more sequential fashion than a more "flattened" polynomial mode choice.

While one could nit-pick or quibble over the functional forms, model coefficients, and utilities contained in the model, from my perspective, the general approach taken is sound. While there are always opportunities to improve travel demand forecasting, it is also critical that reviewers understand and accept the fundamental differences between an approach which uses industry standard best practices for estimating overall travel demand by alternative versus a more limited partial picture of one or more aspects of transit ridership.

Does the Travel Demand Model Provide Useful Information?

While one can also ask for more detailed information about a particular travel mode or class of service, or the impacts on an individual neighborhood, the advantage of the large scale modeling approach is that it enables us to review system-wide effects and to compare the choices of no-build, TSM, managed lanes, and fixed rail alternatives. The disadvantage of this approach, however, is the problem of information overload or sorting out the most useful and important elements for evaluation and decision-making. It should be noted, however, that the Alternative Analysis provides useful information on: 1) the total number of transit trips for each of the different alternatives including fixed rail estimates; 2) the estimated fixed rail boardings for proposed stations; 3) total VMT (vehicle miles traveled), VHT (vehicle hours traveled), and hours of delay for each of the alternatives; and 4) peak hour volumes and LOS (level of service) estimates for screenlines by alternative.

These systemwide measures are useful in a number of ways. They provide an estimate of automobile use versus other modes of travel. The VMT and VHT measures show auto use both in terms of miles and in terms of hours spent on the road. The vehicle hours of delay is a measure of congestion as are the estimates of LOS. There are two kinds of information provided in the Alternatives Analysis report: 1) information about future travel patterns and demand; and 2) information which allows for the comparison of alternatives.

Looking into the future is a difficult, challenging activity. Such is the business of planning. Part of the difficulty arises from the diversity of factors that can affect the forecasts of population, employment, and other activities of travel demand. The model predicts growth in travel demand and in transit trips even under the "no-builld" assumption. The Alternatives Analysis compares the increase in transit trips over the number of transit trips forecast under the "no-build" alternative. While different alignments and configurations for the fixed guideway alternative are presented, it is also important to note the Alternatives Analysis

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enables comparison amongst the alternatives. This is the essence of an alternatives analysis.

Were the alternatives correctly specified? The framework of comparison – existing conditions, "no-build," TSM (Transportation Systems Management), Managed Lane, and Fixed Guideway (four different alignments) is appropriate and reasonable. It should be noted that the bus fleet size used in the analysis grows from 525 (existing) to 614 (no-build) to 765 (TSM) to 846/906 (two direction/reversible managed lane) options. The bus fleet is held closer to existing levels under the guideway alternatives.

It is also important to note that under the Managed Lane alternatives, various estimates of the effects of tolls were determined. Using a modeling approach developed for Houston and constraining the LOS to "C" (1,400 vehicles per hour) which would require a toll of $6.40 on all single and double occupant vehicles (all 3+ occupant vehicles would be free), the effects of tolls were also considered. It is important to note that this alternative is also studied in the OMPO model.

Accuracy, Reliability, and Validity

With travel demand estimation, the accuracy (or correctness) of the results can only ultimately be demonstrated after the system has been built and data collected in 2030. The issue of reliability refers to the reproducibility of the results. In part, this has been addressed in that the OMPO model was run in 2002 (albeit for different alternatives) and then re-run more recently for the High Capacity Transit Corridor Project. An initial inspection of the results indicates that there is a degree of consistency and reliability in terms of the model results. Certainly more information on the reliability of the estimates will become available as parts of the model are re-run as the project advances. Also, because the model is reviewed not just by OMPO and by the FTA, there are opportunities to investigate the reproducibility of the various estimates.

One of the advantages of using the large-scale travel demand forecasting procedure is that there are different ways of validating the results. More extensive documentation of the validation of the OMPO model is available. The validation consists of comparing the estimated to observed travel times for different classes or types of travel for a base year. Typically, an on-board bus survey is done to get ridership and travel time estimates as well data on origins and destinations. These data are compared to modeled or estimated results. A regression model comparing estimated to observed values is calculated, with the R-squared value used as measure of the explanatory or predictive power of the model. While there is need for more documentation of the validation effort for the High Capacity Corridor project, if the estimated travel times and boardings are within a reasonable range of the observed 2005 on-board survey results, then the confidence in the estimates will be increased.

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More effort could go towards the documentation of the modeling procedure. At issue are concerns regarding the aggregation of effects – from the 762 zones to the corridor and the other reporting districts contained in the Alternatives Analysis. There was not sufficient time to do a full audit of the model, nor was there adequate opportunity to examine how the different components from resident based trips to visitor trips and other details were integrated. It is assumed that because these are elements common to the OMPO model and because FTA reviews these details, these aspects of the model can be verified and documented as some later point.

Summary Comments

The methods used in the ridership estimates appear to be sound. The basic structure and approach to ridership modeling, meet industry standards consistent with the "best practice" approach employed by OMPO. It is also somewhat reassuring that the same model which is used by OMPO is also used in the Honolulu High Capacity Transit Corridor Project. The use of the traditional four-step demand estimation procedure with a Fratar trip distribution procedure and a nested logit model is comparable to what is done in other jurisdictions. While there is need for more evaluation of some of the input data – that is information regarding the population estimates, employment growth, and patterns of development to 2030, and while there are always opportunities to improve the specific sub-model components regarding auto ownership, mode choice, induced travel demand, visitor and other special purpose trips, as well as estimates regarding travel preferences as well as the willingness to pay for different types of transportation services, the general approach and set of procedures utilized in estimating ridership are sound.

The Alternatives Analysis provides useful information regarding travel demand, transit use (both presently and into the future), and a basis for comparison of alternatives in terms of key indicators related to transportation such as VMT, VHT, hours of delay, and LOS associated with the baseline, no-build, TSM, managed lane, and fixed guideway alternatives. While additional information could have been provided in terms of other benefits associated with increased choice of travel modes, increased reliability of travel from one point to another, and the differential impact of increased mobility and accessibility for various groups, allowing for more closer inspection of transportation equity and environmental justice requirements of each of the alternatives, these are concerns that might also be addressed in the environmental impact assessment procedure.

The Alternatives Analysis is a fairly digestable document. Unlike others which take hundreds of pages of text, this one seems fairly concise and focused on key issues, concerns, and impacts. As such it provides an adequate base of information on which to make a policy decision as to whether or not to proceed to the next stage of planning and preliminary engineering

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A final comment is that the travel demand estimation procedures and the ridership estimates appear to be somewhat conservative. First, it is important to note that the "best practice" approach employed in this study will yield more reliable results since the techniques are used and tested and evaluated in many other jurisdictions. Second, because the model is reviewed by the FTA, the parameters, utilities, and estimates are constrained by federal guidelines. Third, modest assumptions regarding the cost of gasoline or automobile travel are utilized. They are predicted to grow no faster than the general rate of inflation. Fourth, assumptions regarding future development around stations and the increased ridership associated with transit oriented development or transit adjacent development were quite modest. For purposes of comparison across the various alternatives, the same pattern of land use and population growth and development was used. There has been much research to the contrary, that a fixed guideway system will in fact result in increased densities, resulting in lower automobile use and greater transit ridership. Finally, the utility functions used to specify the willingness to travel by various transportation modes are assumed to remain constant over the period. This is to suggest that people in 2030 will behave much as they do today. The willingness to take a fixed rail guideway system is ultimately based on the willingness of people today to use bus service. This is a conservative approach. The modest growth in transit ridership results from the improvements in transportation services vis-à-vis the various alternatives and alignment choices with constant preferences and utility functions.

While there is always room for improvement in the difficult task of travel demand forecasting, and while we must remain vigilant over the application of various forecasting techniques and the data used as inputs to the model, the ridership forecasts were done using sound methods, providing useful information that is reasonably accurate, reliable, and valid.

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