Honolulu High-Capacity Transit Corridor Project

Operating and Maintenance Cost Estimating Methodology Report

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Executive Summary

The City and County of Honolulu (City), in cooperation with the Federal Transit Administration (FTA), is initiating an Alternatives Analysis (AA), leading to preparation of a Draft Environmental Impact Statement (DEIS), to identify and evaluate high capacity transit service improvements along a corridor between Kapolei and the University of Hawai‘i at Mānoa (UH Mānoa).

The scope of this current work entails detailed planning and conceptual engineering of transit alternatives, and culminates in the selection by the City Council of a locally preferred alternative (LPA) and the development of several documents to be submitted to the FTA, one of which is the Alternatives Analysis Report. In preparing an Alternatives Analysis for this project, a methodology will be developed to estimate the operations and maintenance costs of the various alternatives analyzed.

This Final Operations and Maintenance (O&M) Cost Estimating Methodology Report is a supporting document to information provided in the Alternatives Analysis Report. It describes the approach that will be used in estimating O&M costs - the resource build-up approach, which is a disaggregate method allowing the evaluation of costs in great detail - which is consistent with the approach required by the FTA.

The model will be developed using Microsoft® Excel to estimate annual labor and non-labor O&M costs through the year 2030 for each of the transit modes defined by the study alternatives, and will determine future costs in 2006 dollars using operating data output from the service level model. Employing a cost model based upon this resource build-up approach will sufficiently estimate O&M costs for each of the alternatives defined in the alternatives analysis.

O&M cost estimates for each of the alternatives will be an important part of the cost effectiveness and local financial commitment criteria used in the evaluation of alternatives leading to the selection of the locally preferred alternative. The O&M cost estimates will also comprise part of the project justification criteria submitted to the FTA for its review and ultimate rating of the project.

1 Introduction

The City and County of Honolulu (City), in cooperation with the Federal Transit Administration (FTA), is initiating an Alternatives Analysis (AA), leading to preparation of a Draft Environmental Impact Statement (DEIS), to identify and evaluate high capacity transit service improvements along a corridor between Kapolei and the University of Hawai‘i at Mānoa (UH Mānoa) as shown in Figure 1-1.

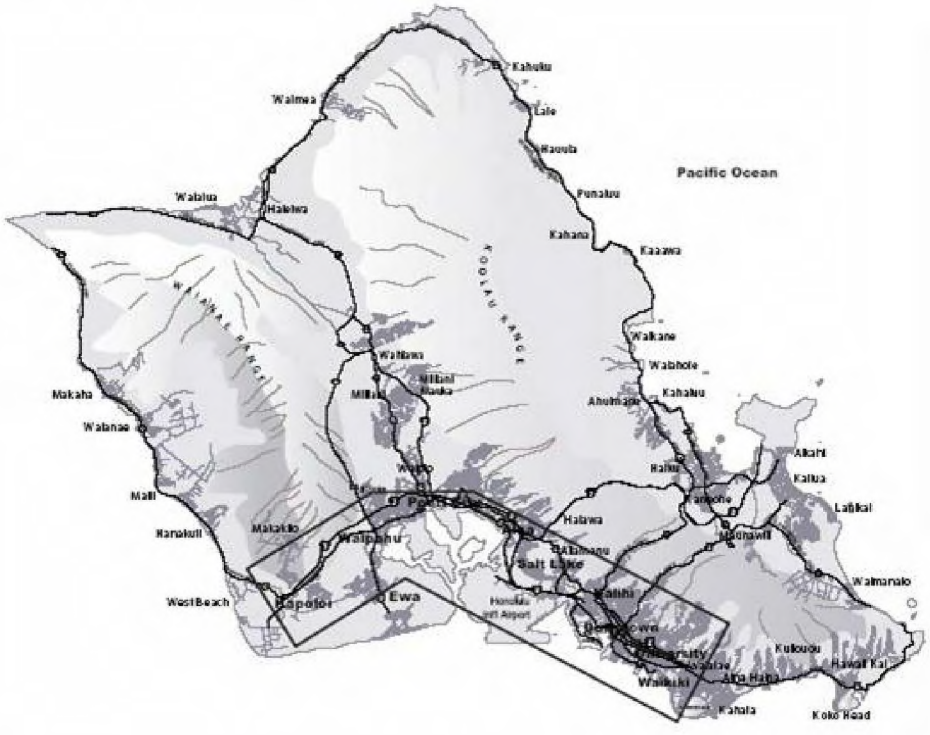

Figure 1-1: Honolulu High-Capacity Transit Corridor

The scope of this current work entails detailed planning and conceptual engineering of transit alternatives, and culminates in the selection by the City Council of a locally preferred alternative (LPA) and the development of several documents to be submitted to the FTA, one of which is the Alternatives Analysis Report. In preparing an Alternatives Analysis for this project, a methodology will be developed to estimate the operations and maintenance costs of the various alternatives analyzed.

1.1 Purpose of this Report

This report is one of a number of reports required by the AA Study that will be produced for the general purpose of providing early information to the FTA and others interested in the project's procedures and findings.

The purpose of this O&M Cost Estimating Methodology Report is to summarize and document the process by which O&M cost estimates will be developed for each of the

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detailed alternatives to be defined. This will primarily involve describing the way in which the O&M cost model will be developed, validated and used.

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2 Existing Transit Service

2.1 Section Purpose

This section provides an overview of public transit service as it currently exists on the island of O'ahu. This overview serves as a point of reference in the context of developing O&M cost estimates for proposed alternative transit services defined by the Alternatives Analysis.

2.2 Organization

Public transit on the island of O'ahu is the responsibility of the City and County of Honolulu, Department of Transportation Services (DTS).

DTS plans, designs, operates and maintains transportation systems; locates, selects, installs and maintains traffic control facilities, devices and street lighting systems; approves plans and designs for construction, reconstruction and widening of public streets and roads; promulgates rules and regulations for the use of streets and roadways; and manages the City's contract for bus and paratransit operations, which is performed by O'ahu Transit Services (OTS), a private, non-profit corporation that operates and maintains TheBus and TheHandi-Van systems (the System).[1]

2.3 System

The service area for the System encompasses the island of O'ahu, which is approximately 600 square miles, with a population of about 836,000. Almost all of the transit capacity is provided within the urbanized area of Honolulu (containing a population of about 720,000) via motor bus and paratransit service. Operating data, as reported by DTS to the FTA National Transit Database (NTD) for the 2005 reporting year, is provided in Appendix A to further describe the System.

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[1] *Department of Transportation Services*. August 2003. City and County of Honolulu. 13 October 2005 <http://www.co.honolulu.hi.us/budget/cityorganization/dts.htm>.

3 O&M Cost Estimating Methodology Overview

3.1 General Approach

The flowchart in Figure 3-1 provides an overview of the steps to be taken to develop O&M costs. The initial phase of the process will involve performing a preliminary operations analysis necessary to identify an operating plan for each alternative. These operating plans, together with the development of other technical data, will constitute the detailed definition of the alternatives.

Once the detailed definition of alternatives has been established, work will then proceed concurrently along two paths. One path will involve the analysis of service and demand levels necessary to develop a final operating plan for each alternative, which optimizes its performance. Finalizing the operating plan will involve detailed transit network coding, analyses of service levels, travel forecasting, and demand/supply equilibration, and will culminate in the development of a variety of estimates for operating parameters (e.g., vehicle-miles, vehicle-hours, peak number of vehicles) that will drive the O&M cost model.

The other path will involve the development of the O&M cost model itself, which will be performed in the following sequence, and correlates to the steps shown in Figure 3-1:

- **Collection and Analysis of Data.** A detailed budget statement and an accurate estimate of service characteristics from a recent stable and representative fiscal year of DTS and OTS will be collected and analyzed. Data will also be collected and analyzed from representative U.S. transit properties for alternatives that include transit modes new to the study area. Where possible, the National Transit Database will also be used as a source in collecting and analyzing information.
- **Calibration of the Model.** The O&M cost model will then be calibrated by identifying those costs that are variable with service levels, and attributing each variable cost item to the service characteristic to which it is most closely tied. The resulting unit costs will then be applied to the service characteristics for each alternative to estimate the O&M cost of the alternative.
- **Validation of the Model.** The O&M cost model will be subsequently validated by applying it to a past fiscal year in which service levels were somewhat different and examining how well the estimated costs match the actual expenditures for that year.

Once the model is validated and estimates of the relevant operating variables that serve as input to the model are developed, the model will be applied to determine O&M costs for the study alternatives. The application of the O&M cost model to future service years and/or transit modes will be straightforward: the service requirements for each alternative - vehicle-miles, for example - will be used in the model to estimate labor and material costs for that alternative. The results will be documented in the O&M Cost Estimating Memorandum on a line-item basis for each alternative so that the source of cost difference(s) between the options can be examined.

In summary, the O&M cost model will reflect historic operations, anticipate future operations, and address all functional responsibilities of the transit property. It will also focus on major cost components, apply consistent levels of service data, apply peer transit property experience, apply readily available information, provide fully-allocated costs for use in cost-effectiveness analysis, be structured for sensitivity analyses, and document the model theory and application.[2]

3.2 Overview of Major Model Components

The resource build-up model approach relies on a number of critical elements, including the following:

- Productivity Ratios
- Unit Costs
- Driving Variables

Productivity ratios describe how labor and materials vary with service levels. These are typically expressed as measures such as "gallons of fuel per vehicle mile", or "number of mechanics per vehicle mile". Unit costs are the estimated costs per unit of service or material required, for example "annual wage per mechanic", or "average cost per gallon of fuel". Driving variables are defined as those that most strongly influence the cost of a particular line item and will be identified for each line item cost. For example, annual revenue bus vehicle-hours will be assumed to be primarily responsible for the cost of bus operators' wages, while annual revenue LRT vehicle-miles would be assumed to be most influential in determining the amount of LRT vehicle maintenance materials and supplies.

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[2] *Estimation of Operating and Maintenance Costs for Transit Systems.* Washington, D.C.: Technology Sharing Program, U.S. Department of Transportation, 1992.

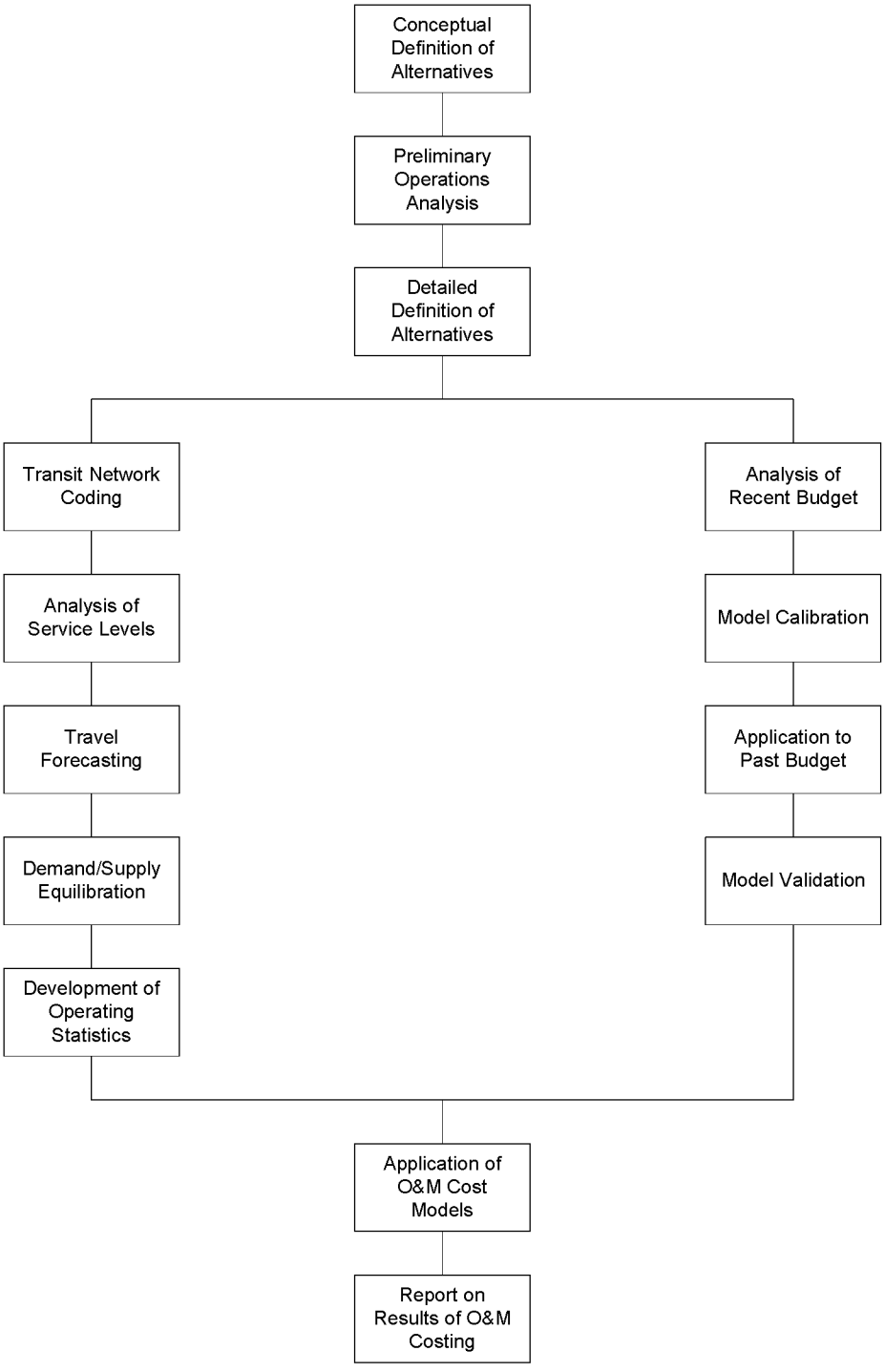

Figure 3-1: Estimating Operating and Maintenance Costs[3]

[3] This figure was based on a similar figure in the following reference: *Procedures and Technical Methods For Transit Project Planning, Part II, Chapter 4, Operating and Maintenance Costs*. Washington, D.C.: Federal Transit Administration, 1990.

4 Detailed O&M Cost Estimating Methodology

4.1 Collecting and Analyzing Data

4.1.1 Bus

Bus operating and financial data will be obtained from DTS, OTS, and, as required, from the National Transit Database (NTD). The data will be collected from detailed budget statements and operating reports from a recent, stable, and representative year for the System. For example, a 34-day strike by OTS bus operators in August 2003 significantly impacted operating and financial data for NTD report year 2004. This would not be considered to be a representative year since the values for variables such as vehicle hours, vehicle miles, annual passengers, platform hours, etc. will be significantly different than a typical year. Data from fiscal year 2004-2005 (NTD report year 2005) will therefore be collected, as this is the most recent and representative year of data.

4.1.2 Rail

Rail operating and financial data will be obtained from peer rail property budgets, the NTD, and other data sources such as the American Public Transit Association (APTA), as required. As with the bus data, rail data will be collected from detailed budget statements and operating reports for a recent and stable year. This data will be obtained from representative rail properties that most closely match the Honolulu environment (if possible), and the proposed service characteristics and rail modes defined for the HHCTC by the alternatives.

4.2 Calibrating the Model

The resource build-up approach to estimating O&M costs, a disaggregate method allowing the evaluation of costs in great detail, will be utilized in developing the O&M cost model, which is consistent with the approach required by the FTA[4]

The O&M cost model will be sufficiently documented to permit simple verification of the assumptions and sources of information used. Every equation and every coefficient in each resource build-up equation will be clearly referenced, including the source of the information used.

In using the resource build-up approach, the model will compute O&M labor and material costs for each mode by calculating unit costs from existing budget and operating data, then applying the unit costs to estimated future operating scenarios.

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[4] *Procedures and Technical Methods For Transit Project Planning, Part II, Chapter 8, Financial Planning for Transit*. Washington, D.C.: Federal Transit Administration, 2003.

Each line item within the model will be assigned a driving variable, which will be the factor that most strongly influences a change in the item's annual cost. Expenses will be modeled as a function of OTS's calibration-year cost, and the calibration-year and future values of the driving variable. It will be implicitly assumed that current rates of consumption and labor productivity will continue into the future.

The general formulae that will be used in this resource build-up model include the following:

Non-Labor:

Annual Non-Labor Cost	=	*Total Base Cost*	÷	*Base Driving Variable*	X	*Future Driving Variable*

where, *Total Base Cost* is the actual non-labor expense for the calibration-year; *Base Driving Variable* is the value of the calibration-year driving variable that most strongly influences a cost item; and *Future Driving Variable* is the future-year input value of the driving variable as defined by the service level model for a particular alternative.

Labor:

Annual Labor Cost	=	*Future Driving Variable*	X	*Labor Productivity Rate*	X	*Annual Cost Per Employee*

where, *Future Driving Variable* is the future-year input value of the driving variable defined by the alternatives analysis[5] ; *Labor Productivity Rate* is the number of positions divided by the *Base Driving Variable*; and *Annual Cost Per Employee* is the average annual earnings, including salary, vacation, holiday, and sick pay, not including fringes such as medical insurance, pension, and social security.

A single O&M cost model will be developed that accounts for transit services currently provided, as well as for those services required by each of the alternatives. Direct costs for each mode will be projected separately within the model, with indirect (overhead) costs allocated among the modes based on capacity miles operated, or other factors as necessary.

Each labor and non-labor cost item for all OTS divisions and departments related to transit operations will be modeled. The model will be based on OTS's current organizational structure, staffing plans, labor productivity, and non-labor consumption rates. Where the model cannot be based on OTS's data as described herein (e.g., transit operations labor for a

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[5] Note that the *Future Driving Variable* will be substituted with the *Base Driving Variable* (the value of the calibration-year driving variable) in initially calculating productivity rates.

fully-automated system), it will be based on similar data obtained from the associated peer property for the mode defined by the respective alternative.

Because operator wages and benefits typically constitute 50 percent or more of total operating costs, specific line items will be included for each unique labor position (e.g., operator, mechanic, etc.) and non-labor expense (e.g., energy (fuel), parts, etc.) for the operations division.

OTS operates diesel motor buses in its demand response (paratransit) operation, and diesel motor bus and hybrid electric motor bus in its standard bus operations. OTS contracts for demand response service. Contracted demand response costs will be calculated as a percentage of total O&M costs since these costs tend to fluctuate with the size of a transit system. The model will be developed to differentiate between buses by size (articulated (60 ft.), standard (40 ft.), and neighborhood shuttles/vans (30-35 ft.)), by energy source (diesel, hybrid, CNG, fuel cell, etc.), where applicable, and between rail technologies as defined by each of the alternatives, e.g., high capacity AGT, LRT, HR, etc. O&M costs associated with all current and planned maintenance facilities will also be estimated.

Based on OTS's calibration-year budgeted expenses, organizational structure, service levels, job classifications, and wage rates, the model will be developed in the steps described in the subsections below.

4.2.1 Identify Driving Variables

The first step in model calibration will be to identify the driving variables and their values that describe current (calibration-year) operations. The variable that most strongly influences the particular cost will be assigned for each of the line items in OTS's detailed budget. For example, the cost of bus operator wages is most strongly influenced by the variable, "annual vehicle revenue hours". The calibration-year driving variable value will be used to establish the productivity rate that will be used, in part, in estimating future costs.

The driving variables identified for the calibration year above will also be used as input variables that will drive the estimation of costs for every item in the model. The values of these inputs will be defined by the operating plans associated with each of the alternatives analyzed, and will be used with the productivity rate discussed above in the equation that estimates O&M costs.

This same approach will be employed in identifying driving variables and values associated with each of the rail peer properties' detailed budgets.

A variable may apply to bus, rail, or both. The driving variables that will be used in the model are summarized by mode in Table 4-1, and described thereafter.

Table 4-1: Driving Variables for the O&M Cost Model

Driving Variable	Bus	Rail
Operating		
Annual Unlinked Passenger Trips	X	X
Bus Routes / Rail Lines	X	X
Vehicles Operated in Maximum Service	X	X
Maintenance Facilities	X	X
Annual Vehicle Revenue Miles	X	X
Annual Vehicle Revenue Hours	X	X
Directional Route Miles		X
Passenger Stations		X
Financial		
Capacity Miles	X	X
Salary Adjustment Factor	X	X
Fringe Rate - Bargaining, Salaried Employees	X	X
Fringe Rate - Bargaining, Hourly Employees	X	X
Fringe Rate - Non-Bargaining Employees	X	X
Alternate Year	X	X

Operating Driving Variables:

Unlinked Passenger Trips. The number of passengers who board public transportation vehicles. Passengers are counted each time they board vehicles no matter how many vehicles they use to travel from their origin to their destination. OTS served approximately 68.1 million passengers in NTD reporting year 2005.

Bus Routes / Rail Lines. The number of directly-operated scheduled fixed bus routes, or number of rail lines defined as train service, operating continuously in a unique corridor. OTS currently operates approximately 90 bus routes.

Vehicles Operated in Maximum Service. The number of revenue vehicles operated to meet the annual maximum service requirement. This is the revenue vehicle count during the peak season of the year; on the week and day that maximum service is provided. For the 2005 NTD reporting year, OTS operated 516 buses in maximum service. Vehicles operated in maximum service exclude:

- atypical days, or
- one-time special events.

Maintenance Facilities. Facilities where maintenance activities are conducted including garages, shops (e.g., body, paint, and machine) and operations centers. OTS currently operates out of four bus maintenance garages.

Vehicle Revenue-Miles. The miles that vehicles are either scheduled to travel, or actually travel, while in revenue service. For the 2005 NTD reporting year, OTS

operated approximately 22.4 million vehicle-revenue miles. Vehicle revenue-miles include miles associated with:

- layover / recovery time.

Vehicle revenue-miles exclude miles associated with:

- deadheading;
- operator training; and
- vehicle maintenance testing; as well as
- school bus and charter services.

Vehicle Revenue-Hours. The hours that vehicles are either scheduled to travel, or actually travel, while in revenue service. For the 2005 NTD reporting year, OTS operated approximately 1.65 million vehicle revenue-hours. Vehicle revenue-hours include:

- layover / recovery time.

Vehicle revenue-hours exclude time associated with:

- deadheading;
- operator training; and
- vehicle maintenance testing; as well as
- school bus and charter services.

Directional Route-Miles. The mileage in each direction over which public transportation vehicles travel while in revenue service. Directional route-miles are:

- a measure of the route path over a facility or roadway, not the service carried on the facility; e.g., number of routes, vehicles, or vehicle revenue-miles; and are
- computed with regard to direction of service, but without regard to the number of traffic lanes or rail tracks existing in the right-of-way (ROW).

Directional route-miles do not include staging or storage areas at the beginning or end of a route.

The base value for this variable in determining the productivity rate will be obtained from OTS data for the bus model, and for the rail model from operating statistics of the peer rail property associated with the alternative being analyzed. The future value for this variable will be obtained for a given alternative from the specific definition of the alternative in the alternatives analysis.

Passenger stations. A passenger boarding / deboarding facility with a platform, which may include:

- stairs;
- elevators;
- escalators;
- passenger controls (e.g., faregates or turnstiles);
- canopies;
- wind shelters;
- lighting;
- signs; and
- a building with a waiting room, ticket office or machines, restrooms, or concessions. Includes all fixed guideway passenger facilities (except for on-street cable car and light rail stops), including busway passenger facilities; underground, at grade, and elevated rail stations; and ferryboat terminals. Includes transportation / transit / transfer centers, park-and-ride facilities, and transit malls with the above components, including those only utilized by motor buses.

This variable does not include stops (which are typically on-street locations at the curb or in a median, sometimes with a shelter, signs, or lighting) for:

- bus;
- light rail; or
- cable car.

The base value for this variable in determining the productivity rate will be obtained from the peer rail property operating statistics required by the associated alternative. The future value for this variable will be obtained for a given alternative from the specific definition of the alternative in the alternatives analysis.

Financial Driving Variables:

Bus Capacity-Miles. The percentage of total transit capacity-miles allocated to bus service.

Rail Capacity-Miles. The percentage of total transit capacity miles allocated to rail service.

Salary Adjustment. A variable used to adjust wages and salaries based on system size. This factor will be a fixed percentage for each additional peak bus or peak rail vehicle operated and will typically apply to staff directly involved in managing the operation.

Fringe Rate - Bargaining, Salaried Employees. The average fringe benefit rate of bargaining, salaried employees in the operations division. Fringe benefits include social security, Medicare, pension, life and medical insurance, uniform allowances,

and workers compensation. Sick, holiday, vacation and other paid leave are included as base wages.

Fringe Rate - Bargaining, Hourly Employees. The average fringe benefit rate of bargaining, hourly employees in the operations division.

Fringe Rate - Non-Bargaining Employees. The average fringe benefit rate of non-bargaining employees in the operations division.

Alternate Year. A variable used to adjust 2006, model-generated O&M costs to future or past-year dollars. This will be used in the validation of the model to compare model-estimated costs to actual costs of the calibration year.

Past experience has shown that certain operating statistics generated by the travel demand forecasting model may be inaccurate due to the number of simplifying assumptions made (e.g., rounding) in developing the model, thereby resulting in overestimates of these operating statistics. As a result, annual vehicles operated in maximum service, annual vehicle revenue hours, and annual vehicle revenue miles will be calculated independently for each of the alternatives, based on the service frequency, travel time, and distance of each bus route and/or rail line. These variables will be validated by comparing estimated values for the no-build alternative with that of DTS's current operations.

Future non-revenue operations such as report, layover and deadhead time, and distance, as well as scheduled and unscheduled overtime, will be implicitly assumed to increase at current proportions. For example, if OTS's scheduled overtime hours is 2% of annual scheduled operator hours, this same ratio would be assumed for all future alternatives.

4.2.2 Determine Labor Costs

Labor costs will be determined using the following formula or a variation thereof:

Annual Labor Cost	=	*Future Driving Variable*	X	*Labor Productivity Rate*	X	*Annual Cost Per Employee*

where, *Future Driving Variable* is the input value for a given alternative of the future-year driving variable as defined by the alternatives analysis (this will be substituted with the *Base Driving Variable* (the value of the calibration-year driving variable) in initially calculating productivity rates); *Labor Productivity Rate* is the number of positions divided by the *Base Driving Variable*; and *Annual Cost Per Employee* is the average annual earnings, including salary, vacation, holiday, and sick pay, excluding fringe benefits such as medical insurance, pension, and social security.

For example, in determining the labor cost of full-time bus operators based on an alternative yielding an input variable of 750,000 revenue bus-hours per year, the model will estimate annual bus operator labor costs as follows:

The productivity rate will first be calculated by dividing the number of budgeted positions for full-time bus operators of 250 by the calibration-year annual revenue bus-hours of 550,000. The productivity rate would be .000454545 (250/550,000).

The estimated annual labor cost would then be calculated using the formula, as follows:

Annual Labor Cost	=	*Future Driving Variable*	X	*Labor Productivity Rate*	X	*Annual Cost Per Employee*
$ 11.9M	=	750,000	X	.000454545	X	$ 35,000

This example reflects an increase in annual bus operator labor costs from $8.75M (550,000 X 250) to $11.9M as a result of the increase in annual revenue bus hours from 550,000 to 750,000, thereby requiring 341 full-time bus operators ($11.9/$35,000). This is an increase of 91 operators (341-250).

Actual data will be different from the data used in this example, and will be based on OTS's budget, operating characteristics, and data yielded by the travel demand forecasting model for each of the alternatives.

Labor costs will be modeled in one of two ways, based on whether the position is an operations position or a support position. For the operations division, every position will be modeled by job classification, listing the base earnings and fringe benefit rate for each. Base earnings include sick, holiday, vacation, and other paid absences, including sick leave time reimbursement. Fringe benefit rates will account for overtime, workers compensation, social security, pension, and insurance. Positions will be distinguished as hourly vs. salaried.

For each support division, labor positions, earnings and fringe benefit rates will be aggregated by the model into a single line item.

4.2.3 Determine Non-Labor Costs

Non-labor costs will be determined using the following formula:

Annual Non-Labor Cost	=	*Total Base Cost*	÷	*Base Driving Variable*	X	*Future Driving Variable*

where, *Total Base Cost* is the actual non-labor expense for the calibration-year; *Base Driving Variable* is the value of the calibration-year driving variable that most strongly influences a cost item; and *Future Driving Variable* is the input value of the future-year driving variable for a specific alternative as defined by the alternatives analysis.

For example, the annual cost of bus parts would be estimated as follows:

The total annual base cost of bus parts will be, for the purpose of this example, $2M, and the number of peak vehicles, 50, is the base driving variable, which is the variable that most strongly influences the annual cost of parts (both of these data are obtained from the information collected from DTS). The future driving variable will be 60 vehicles, which is defined by the particular alternative. The formula would then be applied as follows:

Annual Non-Labor Cost	=	*Total Base Cost*	÷	*Base Driving Variable*	X	*Future Driving Variable*
$ 2.4M	=	$ 2M	÷	50	X	60

This example reflects that as a result of an increase in the number of peak vehicles by 10 to 60, the annual total cost of bus parts would increase by $400,000 to $2.4M.

Actual data will be different from the data used in this example, and will be based on OTS's budget, operating characteristics, and data yielded by the travel demand forecasting model for each of the alternatives.

Non-labor costs will be generally designated as services, material, energy (fuel), utilities, travel, lease, casualty, and miscellaneous, and will be aggregated by cost type for most departments, but modeled in greater detail for the operations division.

4.2.4 Build Line Item Detail Table

The line item detail table contains the model itself, which is primarily the productivity ratios and unit costs determined from detailed OTS budgetary and operating data, and from the representative peer rail properties. Outputs from the model will be the labor requirements (staffing), if any, for each category, and the estimated costs.

Labor and non-labor items will be grouped together by department, with labor items listed first. The detail will describe the category, driving variable, productivity ratio, and unit cost for each category; and the estimated staffing and costs for the service characteristics associated with the specific alternative being analyzed. An example line item detail table is shown in Table 4-2.

Rail traction power costs will be calculated according to estimated vehicle power consumption based on the service defined by the alternative, and the rates for usage and demand charged by the local power utility in Honolulu. This will be reflected in the line item detail table on a summary basis linked to a separate worksheet containing the respective detailed data and calculations.

4.3 Validating the Model

Once the model is calibrated, it will be validated by entering service characteristic data for up to two past (known) fiscal OTS years to determine if the model estimates staffing levels

and costs that are nearly the same as the actual data for the past years. The service levels of the past years will ideally be somewhat different than the calibration year service levels. Any significant variations in the estimates compared to that of the actual data will be analyzed, explained, and where applicable, resolved.

4.4 Determining O&M Costs for the Alternatives

Determining O&M costs for each of the alternatives will be straightforward. The operating requirements for each alternative will be entered into the model to estimate the staffing levels and labor and material costs, as described previously.

Two O&M cost estimates will be generated for each alternative. The first will always be the cost, in 2006 dollars, to operate and maintain the existing DTS bus system at a specified level of service for the year defined by the alternative. The second will be the cost, also in 2006 dollars, to operate and maintain the particular transit system defined by the alternative. For example, that could be a light rail transit system with modified feeder bus service, or it could be a light rail transit system with modified feeder bus service in one location and standard bus route service (as with the existing System) at another location.

Table 4-2: Example O&M Cost Model Line Item Detail Table[6]

1	2	3	4	5	6	7
acct	**resource category**	**driving variable**	**productivity ratio**	**unit cost**	**staff**	**cost (000)**
010	office of director of operations	peak veh	1 staff per 200 peak veh	$47,000 per staffer		
	schedulers	peak veh	1 staff per 65 peak veh	$28,700 per staffer		
	shift supervisor	garage	3 supervisors per garage	$38,400 per supervisor		
	street supervisor	veh-hr	1 supervisor per .14MM veh-hr	$34,100 per supervisor		
	support staff	garage	5 staff per garage	$22,000 per staffer		
032	fuel	veh-mi	.31 gal per veh-mil	$.94 per gal	NA	
	lubrication	veh-mi	--	$.012 per veh-mi	NA	

[6] *Procedures and Technical Methods For Transit Project Planning, Part II, Chapter 4, Operating and Maintenance Costs.* Washington, D.C.: Federal Transit Administration, 1990.

1 acct	2 resource category	3 driving variable	4 productivity ratio	5 unit cost	6 staff	7 cost (000)
033	tires and tubes	veh-mi	--	$.021 per veh-mi	NA	
042	office of director of maintenance	peak veh	1 staff per 250 peak veh	$38,000 per staffer		
	maintenance supervisors	garage	3 supervisors per garage	$36,200 per supervisor		
	support staff	garage	2 staff per garage	$22,000 per staffer		

4.5 Presenting the Data

The output data of the model will be presented in the Memorandum on O&M Cost Estimating Results, with summary tables describing each of the alternatives, the values of their input variables, and the values of the outputs for staffing requirements and costs. Additional summary tables organizing this information according to department and cost type (e.g., labor, services, utilities, etc.) will also be provided. Detailed tables incorporating all data for each of the alternatives will also be developed for use as required.

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5 Conclusion

The alternatives analysis study is intended to provide information to local officials on the benefits, costs, and impacts of alternative transportation investments developed to address the purpose and need for a transportation improvement in the corridor. The ultimate outcome of the study is the selection of a locally preferred alternative from the list of defined alternatives.

In support of this, each of the alternatives will be evaluated according to a set of criteria collectively referred to as project justification and local financial commitment criteria, which generally include 1) mobility improvements; 2) cost-effectiveness; 3) environmental benefits; 4) operating efficiencies; 5) transit supportive land use; 6) local financial commitment; and 7) other factors such as environment justice considerations and equity issues; opportunities for increased access to employment for low income persons and welfare to work initiatives; livable communities initiatives and local economic development initiatives; and consideration of innovative financing, procurement, and construction techniques, including design-build turnkey applications.

O&M cost estimates for each of the alternatives will be an important part of the cost effectiveness and local financial commitment criteria used in the evaluation of alternatives leading to the selection of the locally preferred alternative. The O&M cost estimates will also comprise part of the project justification criteria submitted to the FTA for its review and ultimate rating of the project.

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References

Department of Transportation Services. August 2003. City and County of Honolulu. 13 October 2005 <http://www.co.honolulu.hi.us/budget/cityorganization/dts.htm>.

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Procedures and Technical Methods For Transit Project Planning, Part II, Chapter 4, Operating and Maintenance Costs. Washington, D.C.: Federal Transit Administration, 1990.

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DTS 2005 NTD - Agency Profile Data

	Bus (TheBus)	Demand Response (TheHandi-Van)	Total
Vehicles Operated in Maximum Service	416	100	516
Vehicle Peak to Base Ratio	1.56	NA	NA
Average Fleet Age in Years	7.3	4.7	NA
Annual Vehicle Revenue Miles	18,388,911	4,035,830	22,424,741
Annual Vehicle Revenue Hours	1,365,082	283,396	1,648,478
Annual Unlinked Trips	67,406,827	733,777	68,140,604
Annual Passenger Miles	291,109,916	8,966,697	300,076,613
Service Efficiency			
Operating Expense per Vehicle Revenue Mile	$ 6.91	$ 4.25	NA
Operating Expense per Vehicle Revenue Hour	$ 93.08	$ 60.58	NA
Cost Effectiveness			
Operating Expense per Passenger Mile	$ 0.44	$ 1.91	NA
Operating Expense per Unlinked Passenger Trip	$ 1.89	$ 23.40	NA
Service Effectiveness			
Unlinked Passenger Trips per Vehicle Revenue Mile	3.67	0.18	NA
Unlinked Passenger Trips per Vehicle Revenue Hour	49.38	2.59	NA

DTS 2005 NTD - Operating Expenses by Function (in 000's)

	Bus (TheBus)	Demand Response (TheHandi-Van)	Total
Vehicle Operations	$ 79,491	$ 11,932	$ 91,423
Vehicle Maintenance	$ 26,309	$ 1,977	$ 28,286
Non-Vehicle Maintenance	$ 3,262	$ 297	$ 3,559
General Administration	$ 18,007	$ 2,963	$ 20,970
Total	$ 127,069	$ 17,169	$ 144,238

DTS 2005 NTD - Operating Expenses by Object Class (in 000's)

	Bus (TheBus)	Demand Response (TheHandi-Van)	Total
Operators' Wages	$ 36,550	$ 6,371	$ 42,921
Other Salaries and Wages	$ 21,517	$ 2,534	$ 24,051
Fringe Benefits	$ 37,211	$ 4,305	$ 41,516
Services	$ 2,973	$ 547	$ 3,520
Material and Supplies - Fuel and Lube	$ 9,398	$ 1,056	$ 10,454
Material and Supplies - Tires and Other	$ 8,099	$ 852	$ 8,951
Utilities	$ 1,198	$ 66	$ 1,264
Casualty and Liability	$ 7,638	$ 1,108	$ 8,746
Taxes	$ 2,283	$ 231	$ 2,514
Purchased Transportation	$ 0	$ 0	$ 0
Other	$ 202	$ 100	$ 302
Total	$ 127,069	$ 17,169	$ 144,283

DTS 2005 NTD - Operators' Wages

	Bus (TheBus)
Operating Time - Dollars (in 000's)	
Platform Time	$ 30,941
Straight Time Allowances	$ 1,949
Premium Time	$ 2,798
Non-Operating Paid Work Time	$ 862
Total Amount	$ 36,550
Operating Time - Hours (in 000's)	
Platform Time	1,509
Straight Time Allowances	97
Premium Time	273
Non-Operating Paid Work Time	62
Total Hours	1,941

DTS 2005 NTD - Energy Consumption (in 000's)

	Bus (TheBus)	Demand Response (TheHandi-Van)	Total
Gallons of Diesel Fuel	6,383	641	7,025

DTS 2005 NTD - Employee Work Hours and Counts

	Bus (TheBus)	Demand Response (TheHandi-Van)	Total
Employee Work Hours			
Vehicle Operations	2,106,803	422,989	2,529,792
Vehicle Maintenance	516,671	43,426	560,097
Non-Vehicle Maintenance	65,831	7,185	73,016
General Administration	196,096	39,715	235,811
Total Operating	2,885,401	513,315	3,398,716
Actual Employee Count			
Vehicle Operations	1,013	224	1,237
Vehicle Maintenance	301	27	328
Non-Vehicle Maintenance	36	6	42
General Administration	111	22	133
Total Operating	1,461	279	1,740

DTS 2005 NTD - Service Supplied and Consumed

	Bus (TheBus)	Demand Response (TheHandi-Van)	Total
Vehicles Available for Maximum Service	525	123	648
Service Supplied (in 000's)			
Annual Scheduled Vehicle Revenue Miles	18,474	0	18,474
Annual Vehicle Miles	21,558	5,014	26,572
Annual Vehicle Revenue Miles	18,389	4,036	22,425
Annual Vehicle Hours	1,493	354	1,847
Annual Vehicle Revenue Hours	1,365	283	1,648
Service Consumed (in 000's)			
Unlinked Passenger Trips	67,407	734	68,141
Passenger Miles	291,110	8,967	300,077

DTS 2005 NTD - Maintenance Facilities

	Bus (TheBus)	Demand Response (TheHandi-Van)	Total
General Purpose - Under 200 Vehicles	0	1	1
General Purpose - 200 to 300 Vehicles	2	0	2
Heavy Maintenance	1	0	1
Total	3	1	4

DTS 2005 NTD - Transit Way Mileage

	Bus (TheBus)
Lane Miles	
Exclusive Right-of-Way	1
Controlled Right-of-Way	35
Directional Route Miles	
Exclusive Right-of-Way	1
Controlled Right-of-Way	35
Mixed Traffic	883

DTS 2005 NTD - Age Distribution of Active Vehicle Inventory

	Articulated Bus (60 ft.)	Bus (40 ft.)	Vans (20-35 ft.)
Years			
5 or less	60	120	88
6 to 11	0	213	51
12 to 15	0	67	12
16 to 20	0	0	0
Summary			
Total Active Fleet	60	400	151
Average Age of Fleet (in Years)	3.2	7.9	5.4