Appendix E

Technical Memorandum #6

Evaluation Methodology and Performance Measures

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Evaluation Methodology and Performance Measures

Countywide Transit Plan

FINAL Technical Memo #6

ALAMEDA County Transportation Commission

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Acronyms

Acronym/Abbreviation	Definition
ACE	Altamont Commuter Express
Alameda CTC	Alameda County Transportation Commission
BART	Bay Area Rapid Transit
FTA	Federal Transit Administration
GHG	Greenhouse Gas
HH	Households
MMAP	Multi-Modal Arterials Plan
MPO	Metropolitan Planning Organization
MTC	Metropolitan Transportation Commission
PDA	Priority Development Area
SANDAG	San Diego Association of Governments
TOD	Transit Oriented Development

1.0. Introduction

1.1. Study Process

This Technical Memorandum documents the performance measures and methods that will be used to evaluate the Draft Transit Network Recommendations described in Technical Memorandum #5. The purpose of the memo is to:

- Provide structure and consistency to the evaluation process, and
- Provide decision makers with a procedure for identifying key differences among proposed recommendations.

The evaluation methodology builds on the transit vision and goals adopted by Alameda CTC in March 2015[1], and will be applied to the draft recommendations and proposed network modifications.[2]

Transit Vision and Goals

The performance measures for the Alameda Countywide Transit Plan are derived from the transit vision and goals documented in Technical Memorandum #3. That document provides a description of the linkage between the vision and goals for the Transit Plan and Alameda CTC's vision and goals from the 2012 Countywide Transportation Plan.

Transit Vision

The adopted vision focuses on the challenge to improve transit network efficiency and effectiveness, while providing environmental and economic benefits and is as follows:

"Create an efficient and effective transit network that enhances the economy and the environment and improves the quality of life."

A simple, focused vision sets the stage for an effective performance framework. The strategic goals define what the vision needs to accomplish through a set of separate, yet integrated elements that support the vision.

Transit Goals

Based on the vision, and an understanding of the current conditions in the county, a set of seven transit goals were identified:

[1] See Technical Memorandum #3: Vision and Goals, Alameda Countywide Transit Plan, March 2015
[2] See Revised Draft Technical Memorandum #5: Transit Network Methodology, Alameda Countywide Transit Plan, August 2015

1. **Increase transit mode share**. The number of people living in Alameda County and their auto trips are growing significantly faster than the number of people that are riding transit. If this trend continues, congestion will continue to increase over time and air quality will continue to degrade. To realize a more environmentally sustainable future, transit ridership will need to increase at a rate faster than auto trips. The goal is to not only increase transit ridership, but to increase the per capita use of transit for all types of trips.
2. **Increase effectiveness**. The transit effectiveness goal seeks to increase the number of transit users for the available transit capacity. To achieve a more financially sustainable transit system, it is important to ensure that major transit investments benefit and are used by the greatest number of people, and that supply matches demand.

   Because transit serves multiple purposes in a community, transit effectiveness must also take into account the need to provide a basic level of transit service. During peak hours, transit provides a critical alternative to private auto trips and to travel on highly congested roadways. Transit also serves as the lifeline for transit-dependent populations that may have no other transportation option. Effectiveness (developing transit facilities and services that match demand and generate the highest ridership) must always be balanced with the need to maintain a basic level of service coverage.
3. **Increase effectiveness of inter-regional transit.** One of the roles of transit service in Alameda County is to provide connections to adjacent regions and to the statewide rail network. These services provide alternatives to auto travel on some of the most heavily congested corridors in Alameda County. The Capitol Corridor provides an alternative to travel on I-80 and I-880 from Contra Costa, Solano, Yolo, and Sacramento counties, and ACE provides an alternative to travel on the I-580 corridor from San Joaquin County.

   By maximizing the effectiveness of these transit services that link the state rail network to regional and local transit services, the demand for inter-regional travel on the county's freeway system, as well as vehicle miles traveled and greenhouse gas emissions, is reduced.
4. **Increase cost efficiency**. The cost of providing transit service is increasing in the county without a commensurate increase in service levels or passengers. To maintain and expand transit services, and to increase frequency and service hours, resources must be used as efficiently as possible.
5. **Improve access to work, education, services and recreation**. The transit system should make it easier for people to travel without having

to rely on a car. Integration with appropriate land use and enhanced first- and last-mile connectivity will increase transit viability and overall accessibility.

6. **Reduce emissions**. Alameda County has adopted a goal to reduce greenhouse gas emissions to 1990 levels. With transportation being the single largest contributor to greenhouse gas emissions, shifting travel away from cars and onto transit can help reduce emissions and enhance the quality of life and the environment in Alameda County.
7. **Achieve a state of good repair**. To provide a safe and reliable transit experience for the user, the transit system needs to be in good working condition. Maintenance of the existing transit facilities and fleet need to be balanced against system expansion.

   This is a particularly acute issue for BART, which is the backbone of the county's transit system, but it is also important for the delivery of reliable bus and ferry service. Maintenance of the core network is critical to being able to accommodate future growth of the system.

1.2. Development of Projects Included in Transit Network

In many transit studies, projects included in the evaluation process are proposed by communities, elected officials, or transit advocates as part of a community visioning process and represent a wide range of improvement ideas. Typically, a high-level screening is applied to the initial set of projects to eliminate those that are infeasible or do not meet the goals and objectives as well. This is not the case for the Alameda Countywide Transit Plan. For this planning effort, the Draft Transit Network Recommendations defined during the creation of the network vision were developed through a strategic technical analysis based on a thorough review of existing conditions, existing plans and studies, a market and transit operational analysis, and an understanding of the Alameda CTC's transit vision and goals. As a result, the evaluation of the transit vision network begins with a relatively limited set of Draft Transit Network Recommendations described in Technical Memorandum #5. [3]

The qualitative and quantitative performance measures, described in the rest of this memorandum, represent a refined set of measures that will be used to provide a more robust picture of the performance of the transit vision network as a whole and for individual draft recommendations. The focus of the evaluation will be to provide information regarding the characteristics of

[3] See Revised Draft Technical Memorandum #5: Transit Network Methodology, Alameda Countywide Transit Plan, August 2015

each draft recommendation rather than the development of a rank-ordered list of recommendations. In that context, relationships or inter-dependencies between recommendations will be discussed in detail.

1.3. Network Alternatives

Task 5 generated a set of draft recommendations to help the county make progress towards achieving the transit vision and goals. These draft recommendations are collectively referred to as the transit "vision" network. The vision network will be compared against existing conditions and a future baseline network that is consistent with the projects contained in MTC's Regional Transportation Plan (see Table 1 below).

Table 1: Network Alternatives

#	Network Alternatives	Year	Description
1	Existing Conditions	2010	Land use and transportation conditions as they were in 2010 per the updated Countywide Travel Demand Model.
2	Baseline Conditions	2040	Consistent with MTC's regional transportation plan.
3	Vision	2040	Set of all improvements identified in the Countywide Transit Plan

SOURCE: Parsons Brinckerhoff, 2015

2.0. Evaluating Performance

2.1. Performance Measures

The performance measures were developed to assess how the transit vision network and draft recommendations support implementation of the adopted transit vision and goals. These measures were compared with selected recent transit studies to validate the scope and completeness of the measures used. In particular, the following studies were reviewed when developing the performance measures presented below:

- Sound Transit Long-Range Plan/ST2 Planning: System and Project Evaluation Methodology Report 02/2006
- Sound Transit: North Corridor Transit Project Alternatives Analysis Report 09/20/2011

- City of Seattle and Sound Transit: Ballard to Downtown Seattle Transit Expansion Study 05/30/2014
- SANDAG 2050 Regional Transportation Plan: Technical Appendix 4 – Transportation Project Evaluation Criteria and Rankings
- City of Seattle Transit Masterplan Final Summary Report April 2012
- Community Transit Long Range Plan, 2011
- Federal Transit Administration National Transit Database, updated annually

Performance measures will be used for two types of evaluations, which will be documented in a future technical memorandum:

- **Network:** This evaluation will quantify the anticipated benefits cumulatively resulting from the draft recommendations with respect to each identified goal. Performance measures will be applied to the existing and future baseline alternatives as well as the "Vision" network in order to gauge the relative effect of each network alternative.
- **Project:** The assessment will consider the costs and benefits of both capital and operating activities associated with each draft recommendation or proposed project. General assumptions will be made regarding capital and operating costs for each proposed network recommendation. (Those projects that are already in the project development or environmental phase will not be evaluated.) These cost assumptions will be used only for comparative purposes and are intended to provide information that can be used in prioritizing and/or phasing of project implementation.
    - **Capital:** This evaluation will allow Alameda CTC to do a comparative assessment of capital projects with respect to each identified goal.
    - **Operations**: A significant portion of the county's funds will continue to support operations and maintenance of transit services. The operating performance varies significantly across transit operators. This evaluation will allow Alameda CTC to evaluate operations practices of transit operators.

Both quantitative and qualitative performance measures have been identified for network and project evaluation. These are described below.

Quantitative Performance Measures

Quantitative performance measures for each goal are summarized in Table 2 and are described in the following section.

Table 2: Quantitative Performance Measures

#	Goals	Performance Measures		
		Network-Level	Project-Level Capital	Project-Level Operating
1	Increase transit mode share	Per capita daily transit ridership	Net new riders	
		Percentage of intra-county trips on transit		
2	Increase effectiveness (including inter-regional travel)	Passenger trips per revenue vehicle mile		Passenger trips per revenue vehicle mile
		Miles of dedicated right-of-way	Miles of dedicated right-of-way	
		Daily transit trips (unlinked)	Daily transit trips (unlinked)	
			Reduction in transit travel time (peak/off-peak)	
		Number of transit hubs served, including inter-regional hubs		
3	Increase cost efficiency		Capital cost per net new rider	
			Total cost per boarding	
		Operating cost per boarding		Operating cost per boarding
4	Improve access	Number of HH/jobs within half-mile of transit stops within each service tier	Number of HH/jobs within half-mile of transit stops	
		Number of Communities of Concern affected		
5	Reduce emissions	GHG emissions		
6	State of good repair		Cost of mid-life overhaul and/or replacements before 2045 to be included in cost estimates	

SOURCE: Parsons Brinckerhoff, 2015

The definitions for the quantitative performance measures are as follows:

- **Per capita daily transit ridership**: This measure will be used to compare transit usage normalized with population over time (2010 vs. 2040). For evaluation of networks, ridership and population data will be taken from the travel demand estimation process (using both the Alameda County Travel Demand Model as well incremental approaches to ridership forecasting as detailed in the Attachment B of Technical Memorandum #7 - Evaluation of Alternatives). For evaluation of operations, ridership data reported by transit agencies and population estimates/projections prepared by state or regional agencies will be used.
- **Percentage of intra-county trips on transit**: This measure will be used to track progress towards increasing transit mode share for intra-county trips.

For evaluation of networks, intra-county ridership data will be taken from the travel demand estimation process (using both the Alameda County Travel Demand Model as well incremental approaches to ridership forecasting as detailed in the Attachment B of Technical Memorandum #7 - Evaluation of Alternatives).

- **Net new riders**: This measure will be used to compare the ability of a project to attract new riders to transit. This measure will be used for evaluation of projects only and will use estimates of net new riders from the travel demand estimate process.
- **Passenger trips per revenue vehicle mile**: This measure will be used to assess the utilization of service for both networks and projects. For network and project evaluations, the passenger trips will come from the travel demand estimation process, while the revenue vehicle mile data will be derived from proposed service levels.
- **Miles of dedicated right-of-way**: This measure is a proxy for the reliability of transit service under the assumption that exclusivity reduces schedule variability associated with intermittent general purpose traffic congestion. The measure will be used for both network and project evaluations. The data will come from each project definition.
- **Daily transit trips**: This measure will show the transit trips associated with the project and will be aggregated at the network level. This measure is being used in addition to net new riders to allow for comparison to other transit agencies and provide input to efficiency metrics such as passenger trips per revenue vehicle miles. This data will come from the travel demand estimation process.
- **Reduction in transit travel time**: Transit travel time improvements will be estimated based on the type of physical changes proposed for the corridor. This measure will be applied at the project level. This data will come from a combination of synthetic and incremental modeling exercises (as detailed in Section 2.2 and the Attachment B of Technical Memorandum #7 - Evaluation of Alternatives).
- **Number of transit hubs served, including inter-regional hubs:** This measure will show the "interconnectivity" of a particular transit line. This data will come from project definition evaluated against the existing and planned transit hubs. This metric identifies "interconnectivity" opportunities (in terms of the number of hubs served or connected) and will be considered in combination with the qualitative metric, "intermodal connectivity" to identify the full potential benefits of a transit improvement project.
- **Capital cost per net new rider**: This measure will be applied at the network and project level. Capital costs will be estimated from data bases that

have compiled costs for comparable types of improvements in Alameda County and in other regions.

- **Operating cost per boarding**: This measure will be applied at the network and project level. Operating costs will be estimated from current operating costs for comparable types of service in Alameda County and other regions.
- **Total cost per boarding:** This measure will provide the total cost per boarding, and will be calculated based on total boardings, capital costs, and operating costs reported by the appropriate measures.
- **Number of households (by income level) and jobs within a half-mile of transit stops**: This measure provides useful information related to the potential overall market and equity issues associated with proposed service changes. It will be applied at the network and project levels. It also provides a measure that helps provide context for the comparison of proposed projects in Alameda County to similar transit projects implemented elsewhere in the US.
- **Number of Communities of Concern affected:** This measure will help to establish whether the proposed modification will have a positive impact on Communities of Concern, i.e. those communities that face particular transportation challenges, either because of affordability, disability, or because of age-related mobility limitations. These may also be defined as those areas covered by Community Based Transportation Plans. A qualitative assessment of the extent to which proposed transit improvements benefit these communities will also be performed.
- **GHG emissions:** This measure will be applied on the network-level only and is generated based on output from the travel forecasting process (using both the Alameda County Travel Demand Model as well incremental approaches to ridership forecasting as detailed in the Attachment B of Technical Memorandum #7 - Evaluation of Alternatives).
- **Cost of mid-life overhaul and/or replacements before 2045:** In order to reflect the goal of state of good repair, project cost estimates will take into account the cost of a mid-life overhaul and capital replacement required before 2045 as appropriate depending on asset type. This information will be obtained from individual transit operators as well as form the consultant team's database of relevant transit capital projects.

Qualitative Performance Measures

In addition to the quantitative measures listed above, the projects will also be evaluated using a set of qualitative performance measures to capture those

benefits that cannot be readily modeled or forecasted so as to provide a quantitative metric. Qualitative measures include:

- **Support TOD strategy:** Linking transit investment with supportive land use patterns is critical to the success of transit. This performance measure will assess the characteristics of land uses adjacent to the proposed transit project to assess the potential for transit success.
    - *Density* – Are high density development and housing affordability requirements in place for development near transit stations/stops?
    - *Mix of Uses* – Does the local jurisdiction have policies that encourage mixed-use development, such as, zoning codes that allow a mix of uses, form-based development codes (which generally facilitate mixed use development or co-locations of different uses better than conventional zoning approaches), innovative jobs/housing balance policies and programs, shared parking allowances or requirements?
    - *Parking Management Policies* – Does the local jurisdiction have progressive parking policies, such as, value or demand priced parking, reduced parking requirements in areas served by transit, parking maximums, shared parking policy, reduced parking for affordable housing units, provision of free or reduced-cost transit passes, and a tracking system to monitor these programs?
- **Number of existing or planned major activity nodes served:** Major activity nodes with high levels of transit demand serve as anchors for transit routes. Generally, major activity nodes are locations where there are a concentrate number of trip destinations and/or origins, such as colleges or universities, downtown central business districts, shopping centers, and large medical centers. The routes that are most productive, not only have major anchors at each end of the route, but also have the potential to generate robust transit demand along the route.

  Proposed projects will be evaluated in terms of how well they serve multiple existing or planned major activity nodes (including active PDA's).
- **Intermodal connectivity**: Projects will be evaluated in terms of how effectively they connect different types of transit services within the transit network. This will be evaluated by assessing the number of transit service tiers served and the ease of access between different transit modes, including first- and last-mile connecting services.
- **Customer experience:** Customers' expectations evolve as amenities and services become available to them. Most transit agencies in Alameda County have carried out customer satisfaction surveys to identify factors that affect their decisions to use transit. Most agencies have also adopted

performance measures to track customer satisfaction over time. A qualitative assessment will be made of each project's impact to the rider's experience based on factors such as: service reliability, ease of transfers, ease of access to transit information and whether or not the proposed project has the potential to improve customer satisfaction.

- **Compatibility with Arterials Plan recommendations**: Coordination with the Arterials Plan typologies will ensure consistency between both plans.

2.2. Modeling Considerations

Because forecasts of transit demand associated with individual or groups of draft recommendations are a critical input to several of the most important evaluation criteria, it is important to understand the advantages and disadvantages of different modeling procedures and how the results should be interpreted. Therefore, a brief discussion of travel demand modeling and the proposed combined approach is provided below.

This evaluation employs a combination of **synthetic** and **incremental** approaches to forecasting transit ridership.

The **synthetic** evaluation method uses a travel demand model (in this case, the 4-step Alameda County Travel Demand Model), which forecasts both travel mode choice and route choice based on statistical estimates of origins and destinations given future land use and transportation system changes.

Incremental approaches to transit ridership forecasting are based on observed transit usage. They forecast transit ridership changes by applying demand elasticities to whatever type of change is being made (fares, frequency, etc.).

An FTA-sponsored survey of MPOs found that 63 percent of the respondents used service elasticities to forecast ridership and 51 percent used 4-step travel models, with many using both in combination. The primary reason for using both is that each method has important limitations that can be overcome through the use of the other method. This can be seen in the comparison table below (see Table 3).

Table 3: Network Alternatives

Synthetic Methods (4-step models)	Incremental Methods (elasticities)
Advantages • Sensitive to changes in land uses and to transportation projects, including improvements in other modes • Can forecast ridership for new modes or extension of an existing mode to areas not previously served	Advantages • Use of route-level survey data eliminates the upstream error (land use data, income data, etc.) found in travel models. The base ridership will be accurate • Can be used to forecast changes for small-scale projects
Weaknesses • Intended to function at a large scale; incapable of forecasting effects of micro-scale projects such as queue jumps • Provides reasonable forecasts for transit as a whole but not for individual bus routes	Weaknesses • Critically dependent on data for existing conditions, so cannot be used where service does not already exist • Insensitive to other changes in the network such as improvements to a parallel freeway

SOURCE: Parsons Brinckerhoff, 2015

As is the case with virtually all synthetic approaches which rely on travel demand models, the Alameda CTC travel demand model is much more accurate for auto travel than for transit, especially bus transit. However, the model is validated (tested for accuracy) at the level of daily ridership by transit operator.[4] In other words, the model is expected to provide a good estimate of total daily ridership for each transit operator, but is not validated for more detailed levels of analysis, such as ridership on individual bus lines at different times of the day.

Many of the draft recommendations to the Alameda County transit network involve a combination of small-scale improvements to bus routes and specific roadways (e.g. transit signal priority, bus bulbs, transit queue jumps, etc.). Synthetic models are not sensitive to these types of changes even though there are examples of transit ridership gains as the result of transit speed and reliability improvements.[5] For the evaluation phase of this project, a combination of synthetic and incremental approaches will be utilized in order to capture the advantages of each analysis approach and overcome the limitations that either approach would have if used alone.[6]

[4] See Table 3-15 in Alameda Countywide Transportation Model Update – Model Documentation, Dowling Associates, August 2011
[5] For a case study of King County Metro Rapid Ride, see Technical Memorandum #5: Transit Network Methodology, Alameda Countywide Transit Plan, August 2015
[6] For further detail, see the Attachment, Technical Memorandum #5.4, Proposed Modeling Approach, Alameda Countywide Transit Plan, August 2015.

2.3. Application of Performance Measures

Results from the evaluation of draft recommendations using quantitative and qualitative performance measures will be presented in a matrix format. The transit vision network will also be evaluated against existing conditions and baseline conditions networks. For each performance measure, results will be presented on a three-point scale (low, medium, high). Each performance measure will be assigned weights determined through discussions with Alameda CTC. Table 4 shows a sample evaluation matrix.

Table 4: Sample Evaluation Matrix

Project	Quantitative Performance Measures														
	Per Capita Transit Ridership	Percentage of Intra-County Trips on Transit	Net New Riders	Passenger Trips per Revenue Vehicle Mile	Miles of dedicated right-of-way	Capital cost per net new rider	Daily Transit Trips	Reduction in Transit Travel Times	Operating Cost per Net New Rider	Number of Transit Hubs Service, including Inter-regional hubs	Operating Cost per Boarding	Number of HH/jobs within half-mile of transit stops	Number of Communities of Concern affected	GHG Emissions	Cost of mid-life overhaul and/or replacements before 2045 to be included in cost estimates
Project 1	○	●	◐	○	◐	◐	●	◐	○	◐	○	●	●	○	●
Project 2	●	◐	◐	○	●	◐	◐	○	◐	○	●	◐	●	◐	○
Project 3	◐	◐	○	○	◐	◐	●	◐	●	◐	◐	●	◐	●	◐
Project 4	●	●	●	◐	◐	●	○	◐	●	●	●	○	○	○	●
Project 5	○	○	◐	●	○	◐	○	○	●	○	◐	◐	◐	○	◐

Legend: ○ 1 – Low Score; ◐ 2 – Medium Score; ● 3 – High Score