Discussion-piece #1
Allowances in the Valuation of Project Benefits and Determination of Cost-Effectiveness
For Proposed New Starts Projects
Federal Transit Adminsitration; June 6, 2006

1. Measures for FTA ratings. The FTA measure of cost-effectiveness for New Starts projects is cost per hour of user benefits. FTA defines cost as the annualized incremental capital cost of the project plus the incremental operating and maintenance cost of the transit system in the forecast year (currently 2030). FTA defines user benefits are the equivalent hours of traveltime savings associated with improvements in transit service levels for all users of the transportation system. Both incremental costs and user benefits are computed against a baseline alternative that represents the best cost-effective transit services that could be offered without a major guideway investment. FTA uses a set of breakpoints to translate the value of the cost-effectiveness measure for each project into a cost-effectiveness "rating." Currently, projects with values below $11.50/hour receive a "high" cost-effectiveness rating, while projects with values above $23.00/hour receive a "low" cost-effectiveness rating. Intermediate breakpoints determine "medium-high," "medium," and "medium-low" ratings.

2. Comments. Some observers have commented that both the user benefits measure and the cost-effectiveness measure assume that mobility improvements represent all benefits of major transit projects. These observers note that the user benefits measure reflects only the quantifiable impacts of transit service changes and that the cost-effectiveness measure counts only user benefits in the comparison with project costs. These comments demonstrate the need for a clear discussion of both the user benefits measure and the breakpoints used to assign cost-effectiveness ratings.

3. User benefits for transit riders. The user-benefits measure is designed to capture all quantifiable benefits to travelers using the transit and highway systems. The value of the measure for any project derives directly from the local travel forecasting procedures that are used to forecast transit ridership, highway volumes, and other characteristics of urban travel. Consequently, the measure captures the benefits associated with whatever characteristics the local travel models understand to be important determinants of the attractiveness of transit (and autos) to travelers. Currently, all travel models characterize transit service quality in terms of travel time (in vehicles, walking, waiting, and transferring) and cost (fares, fees at park/ride lots), and perhaps a few other measured attributes (number of transfers, transit/pedestrian-friendliness at the beginning and/or end of the trip). The longer list of important attributes includes a number that usually remain unmeasured in current models (span of service, reliability, passenger amenities, ride quality, personal safety, and others). The contribution of these attributes to the attractiveness of transit is represented by "constants" that quantify, in the aggregate, the net differences in these "unmeasured" attributes across the alternative. When calibrated against current travel patterns that include a variety of transit modes, these constants are the best-available information on the full set of benefits associated with fixed-guideway transit. Because the user benefit measure derives directly from the transit characteristics transit known to individual local travel models – including all times, costs, other measured attributes, and the unmeasured attributes represented by the constants – the measure gives full credit for all changes in mobility caused

by transit improvements as they are understood by the local models. These mobility benefits are expressed in terms of equivalent minutes of travel time because some common metric is needed to quantify the benefits; however, this metric is simply a conversion of the full range of benefits understood by local travel models and quantified by the user-benefits measure. As travel forecasters expand the attributes grasped by their models – to include reliability or the presence of passenger amenities at stations, perhaps – the user benefits measure will capture the benefits associated with those additional attributes without any change to the definition of the measure or the software used to compute the measure.

4. User benefits for highway users. Both the definition of the user benefits measure and the software used to compute its value are designed to recognize benefits caused by changes in highway service levels. This definition permits the evaluation of transit alternatives, multimodal alternatives, and highway-only alternatives on an even footing. In principle, it also permits the quantification of user benefits associated with the congestion relief effects of major transit projects. However, early quality-control reviews of predicted congestion-relief impacts suggested that the forecasts varied widely in terms of magnitude and geographic distribution within metropolitan areas. Subsequent FTA-contracted research confirmed the general instability of predictions of congestion relief with current practice in model application. Significant FTA-contracted efforts to improve upon current practice indicated a wide range of barriers to the reliable and nationally consistent quantification of congestion-relief impacts. These barriers include the relatively crude methods used in current models to represent congestion effects, the general inattention to the accuracy of speed estimates, and substantial inconsistencies nationally in the methods used to predict of highway speeds in metropolitan areas. Consequently, while the user benefits measure is designed to include benefits derived from changes in highway levels of service, FTA has concluded that current practice is insufficient to support decision-grade forecasts of those benefits. Therefore, in current evaluations of proposed New Starts projects, FTA considers directly only those user benefits derived directly from changes in transit service characteristics. Should the reliability of highway speed predictions improve, FTA may revisit this decision.

5. Cost-effectiveness measure. The measure of cost effectiveness that FTA uses in project evaluation is defined as:

$$CEI = \frac{\text{Incremental annualized capital cost + incremental operating/maintenance cost}}{\text{User benefits}}$$

Where:
- CEI is the cost-effectiveness index;
- capital costs are annualized base on economic lifetimes of scope elements;
- O&M costs are considered only in the forecast year, currently 2030; and
- user benefits are also considered only in the forecast year.

Incremental costs and user benefits are computed against a low-cost “baseline” alternative that represents the best that can be done in the corridor without a major capital investment and highlight be benefits and costs of a new guideway.

The CEI does <u>not</u> employ the classical "present value" method to consider streams of benefits and costs over time. That method would array all costs and benefits over the lifetime of the project (at least 30 years), discount future-year values with an appropriate discount rate (currently 7.0 percent for federal projects as set by the Office of Management and Budget), and sum the discounted values to a lump-sum present value. In contrast, the FTA measure simplifies the information requirements in two ways. First, it considers O&M costs and user benefits only in the forecast year rather than as a stream of values over 30 (or more) years. Second, it annualizes the capital costs directly from their economic lifetimes (100 years for tunnels, 35 years for rail vehicles, and so forth) regardless of the year in which those costs are incurred. These simplifications have a potentially large impact on the resulting measure. The present-value approach would discount the benefits (that occur later in the project's lifetime) much more heavily than the capital costs (that occur early). The simplifications ignore these timing differences, give credit for a relatively larger share of the benefits, and yield a lower (more favorable) CEI. The resulting differences between the present-value approach and the simplified approach are an increasing function of the duration of the construction schedule and the pace of growth in both user benefits and O&M costs over time. Table 1 is a spreadsheet that permits testing of the impacts of different schedules and growth rates. Tests indicate that the FTA method produces a CEI that is 20 to 30 percent lower than the present-value method for a typical New Starts project.

6. <u>Cost-effectiveness breakpoints.</u> FTA derived the breakpoints used to convert CEI values into cost-effectiveness ratings from USDOT-wide guidance on the value of travel time. The departmental guidance sets the value of travel time at one-half of the median household income (expressed in dollars per hour) for all travel. In 2004, the national median household income translated into a value of time of $11.10 per hour. Consequently, a project that generates user benefits at a cost of $11.10 per hour or less returns mobility benefits whose value is greater than the cost of the project. However, that calculation ignores secondary and indirect benefits of projects, including congestion relief and economic development. To recognize these benefits, FTA has established allowances of 20 percent for congestion relief and 100 percent for economic development and all other indirect benefits. In 2004, this combined allowance of 120 percent applied to the $11.10 per hour value of time yielded a total per-hour value of $24.42 that FTA rounded up to $25 per hour. FTA then assigned a "low" rating for cost-effectiveness to projects returning benefits at a cost higher than $25 per hour, and used more stringent breakpoints to assign higher ratings. These breakpoints have since been updated using the Gross Domestic Product (GDP) price deflator to the values that FTA will use in calendar year 2006.

7. <u>Allowances.</u> From this summary, it is evident that FTA's method for evaluating cost-effectiveness includes a number of allowances for imprecision in the prediction and valuation of benefits.

    - First, the FTA method for computing annualized costs and benefits ignores timing effects that, in the classical present-value method, would apply a discount to project benefits that average 20 to 30 percent more than the discount to project costs. So, assuming a mid-range value of a 25 percent effect, the FTA method values an hour of benefits at 1/0.75 = 1.33 times the strict method.

- Second, per Departmental guidance, FTA sets the value of time for work travel equal to one half the median household income. The valuation is in contrast to the work-trip value of time commonly found in models of urban travel (that are used to predict ridership and user benefits for proposed projects) of one quarter to one third of median income. Consequently, the FTA method values an hour of work-trip user benefits at approximately 0.5/0.3 = 1.67 times the strict method.

- Third, and also per Departmental guidance, FTA applies the same value of time to all trip purposes. This valuation is in contrast to the lower non-work-trip values of time commonly found in urban travel models. Assuming that non-work travel models value time at 75 percent of travel time in work-trip travel models, the FTA method values an hour of non-work user benefits at approximately 1.0/0.75 = 1.33 times the work-trip value and 1.33 x 1.67 = 2.22 times the strict method.

- Fourth, the breakpoints that FTA uses to assign cost-effectiveness ratings include a margin of 120 percent to allow for the secondary and indirect benefits of projects. Compared to a strict method that ignores secondary and indirect benefits, the FTA method values an hour of travel time at 2.20 times the strict method.

Together, these four allowances provide a substantial margin for error in the valuation of cost-effectiveness. Assuming a project with user benefits derived equally from work and non-work travel, their combined effect is:

$$1.33 \times [(0.5 \times 1.67) + (0.5 \times 2.22)] \times 2.2 = 5.2$$

That is, the FTA method of evaluating cost-effectiveness values each hour of user benefits at approximately five times the value that would be derived from a strict accounting. Clearly, then, the FTA method makes substantial allowances for (1) errors in prediction of direct transportation benefits and (2) the absence of secondary and indirect benefits.

8. Implications. Efforts to quantify and value other benefits of proposed New Starts projects, should they succeed, would permit FTA to assign project ratings based on estimates of benefits that are tied more closely to individual projects. To the extent that the newly quantified benefits are already included (roughly) in the allowances made in the current evaluation approach, quantification of additional types of benefits would require an adjustment in the breakpoints that FTA uses to assign cost-effectiveness ratings. The net effect would be a more precise evaluation of individual projects and more favorable ratings for projects that would generate relatively more secondary and indirect benefits. However, projects that would generate relatively fewer of those additional benefits would receive less favorable ratings compared to the current approach, and the net effect on the overall number of projects with favorable outcomes might well be more-or-less neutral.