06-Gates

Transit Economic Requirements Model (TERM)

Introduction

The Transit Economic Requirements Model (TERM) is used by the FTA Office of Budget and Policy to estimate transit asset conditions and the amount of transit capital investment required for the transit sections of the "*Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance,*" a biennial report to Congress. This report provides Congress with information on the current state of the Nation's surface transportation system and estimates of the amount of funding that will be required to maintain and improve the conditions of transit assets and performance over a 20-year forecast period. TERM and TERM estimates are based on data obtained from a variety of sources including the National Transit Database (NTD), Metropolitan Planning Organizations (MPOs), FTA research projects, and special data requests to the nation's local transit operators.

A new version of the Conditions and Performance report is being prepared for release in 2008. It will inform debate on reauthorization of the surface transportation bill. The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) is set to expire in 2009. Development of input for this report is complicated by several issues. The analysis relies on an extensive data set that must be updated to meet the standard that none of the data is more than five years old. Much of the data collected in NTD is primarily used for TERM. This data undergoes an extensive validation process (it is also used for apportionment of grant funds). The NTD has an annual budget of over $300 million. Data is also collected from Metropolitan Planning Organizations in some 300 urbanized areas, and from a number of other sources as described below.

Since the output of TERM has such high visibility FTA maintains an ongoing program of identifying deficiencies and carrying out studies to address them. This process has been going on for a decade. Current efforts are looking at how TERM models track wear and how it models depreciation of facilities such as stations and maintenance yards. FTA's TERM contractors are conducting site visits at transit agencies all over the country to collect data to improve these aspects of TERM.

The greatest challenge is presenting results to Congress in the 400-page Conditions and Performance report. The report provides background information, highlights trends, and projects investment needs for maintaining or improving service conditions under the expected growth in ridership. Special analysis are sprinkled throughout the report, some as small as sidebars, others constituting whole chapters. Bridge and highway needs from Federal Highway Administration (FHWA) analysis are also included and make up the larger part of the report. FHWA uses different methods but presents results in a similar format. Production of the report is coordinated between FTA and FHWA but the analysis are separate. In the future we hope to be able to integrate the analysis to evaluate cross-mode investment alternatives.

General description of how TERM works

TERM is a PC based computer application designed to estimate the nation's transit capital investment needs over an extended time horizon. The model estimates the total amount of annual capital expenditures required over a twenty-year period to maintain or improve the physical condition and performance the nation's transit infrastructure. These annual expenditure estimates are provided for each of three major capital investment categories — (1) asset rehabilitation and replacement, (2) asset expansion, and (3) performance improvements — and are further subdivided by transit mode, asset type (vehicles, stations, structures, etc.) and urbanized area characteristics (e.g., size, FTA region). The model output also includes estimates of the physical condition of the nation's transit asset base — both for the current year and for a 20-year forecast period.

TERM allows the user to create a wide range of capital investment scenarios and analyses. For example, the user can evaluate the impacts of variations in asset rehabilitation and replacement polices, budget constraints, inflation rates, discount rates, and other input parameters on annual expenditure levels and future asset conditions.

TERM was developed using Microsoft Access and BASIC software and is designed to run on a Pentium equipped PC (or better). It includes a detailed database documenting a wide range of transit related data required to perform model computations. TERM uses six different analytical modules to estimate the nation's transit capital needs for the next twenty-years. These modules include:

- ***Rehab–Replacement Module (Maintain or Improve Condition):*** The Rehab-Replacement Module estimates the total investment required for ongoing rehabilitation and replacement of the nation's existing transit assets over the next twenty-years, including reinvestment in existing fleet vehicles, maintenance facilities, stations, guideway and trackwork, and train control and traction power systems. This module combines a detailed inventory of all US transit assets with a set of asset-specific decay curves to determine when individual transit assets in the inventory will require rehabilitation or replacement over the twenty-year forecast period. The model records these expenditures in a tally of national transit capital needs.
- ***Asset Expansion Module (Maintain Performance):*** The asset expansion module estimates the level of investment in new, expansion assets that will be required to maintain the quality of existing transit services given projected growth in travel demand. This module first estimates the rate of growth in transit vehicle fleets required to maintain current vehicle occupancy rates given a projected growth rate in transit passenger miles (TPM) by urbanized area (UZA). This module also invests in the expansion of other assets needed to support projected fleet growth. These latter investments include maintenance facilities and, in the case of rail systems, additional route miles made up of guideway, trackwork, stations, train control and traction power systems. Asset expansion investment needs are assessed for all agencies reporting to the National Transit Database (NTD) by mode.

- ***Reduce Crowding Module (Improve Performance):*** The Reduce Crowding Module is one of two modules designed to estimate the level of investment required to improve transit service standards to a target level. The module identifies local agency-modes with a high vehicle occupancy or "crowding," i.e., high ridership per peak vehicle relative to the national average for that mode. This module invests in additional fleet capacity as needed to reduce peak vehicle crowding in these agency- modes to an acceptable level of service standard defined as the national average of riders per peak vehicle plus one standard deviation. If the increase in fleet size is sufficiently large, this module will also invest in additional expansion assets such as maintenance facilities and, for rail systems, additional route miles (including guideway, trackwork, stations, train control and traction power systems).
- ***Benefit-Cost Module 1 (Maintain/Improve Condition, Maintain Performance):*** This module assesses the cost-effectiveness of investments proposed by the Rehab-Replacement and Asset Expansion Modules. If the projected benefits exceed the projected costs, then TERM includes the rehab-replacement and expansion needs estimates for that agency-mode in the tally of national investment needs. If the projected costs exceed the projected benefits, TERM gives the agency-mode a "second chance" by removing the costs and benefits of asset expansion and retesting to see if the agency-mode is cost-effective on the basis of the rehab-replacement investments only. If both benefit-cost tests fail, no rehab-replace and expansion investments for this agency-mode are included in the national tally of transit capital investment needs. However the agency-mode is still assumed to be operated.

TERM's database includes a set of over fifty different statistically estimated decay curves, each designed to estimate the current (and future) physical condition of a different asset type based on its age, utilization and maintenance history. As previously noted, TERM uses these decay curves to determine those points in the asset life cycle (i.e., condition ratings) at which assets will require rehabilitation and ultimate replacement within the Rehab-Replacement Module.

Beyond merely determining when the individual assets recorded in TERM's asset inventory will require replacement, these asset decay curves are also used to evaluate the current physical condition of the nation's transit assets. Since each of TERM's decay curves use the same condition rating scale, the condition ratings assigned to each individual asset type can be aggregated across broad groupings of assets regardless of type. This allows TERM to generate overall measures of average asset condition for whole asset categories (e.g., vehicles or facilities), for individual transit agencies, FTA regions, and all transit assets nationwide.

In addition to providing estimates of the current physical condition of the nation's transit infrastructure, TERM also provides forecasts of how these conditions can be expected to change over a twenty-year forecast period. It is this capability that allows TERM to run the "maintain" and "improve" conditions scenarios. Under the "maintain" conditions scenario, TERM estimates the current physical condition of the Nation's transit assets. The user then iteratively (by trial and error) adjusts the replacement thresholds for five asset categories (guideway, facilities, systems, stations and vehicles) until the aggregate condition for these categories at the end of the model run is equal to their starting condition thus, on average, "maintaining conditions". Under the

improve conditions scenario, the user adjusts the replacement thresholds for the five asset categories until it attains the desired overall condition rating.

The asset decay curves that support these condition estimates were developed using data from two primary sources. Asset decay curves for bus and rail vehicles, maintenance facilities and stations are based on data from on-site asset condition assessments performed at a statistically valid sample of transit agencies across the country, collected specifically to support the estimation of transit asset conditions by TERM. Decay curves for all other asset types were obtained from a detailed, Engineering Condition Assessment (ECA) study completed for the Chicago Transit Authority (CTA) in the early nineteen nineties.

TERM is generally run to yield "unconstrained" estimates where expenditures are not constrained by existing funding capacity. However, it can also estimate transit conditions and performance under the assumption that capital expenditures in future years are constrained to reflect "real" funding realities. Specifically, a "constraint" feature allows the user to limit the annual level of funding available for rehabilitation and replacement activities.

The primary benefit of the constraint feature is to allow the user to compare and evaluate the likely impact of different capital funding scenarios on future asset conditions, for example, to determine whether recent funding levels are sufficient to maintain or improve the current physical condition of the nation's transit assets. When funding is constrained, asset replacement is delayed, average asset ages increase and aggregate asset conditions will likely be lower than if conditions and were maintained or improved.

TERM uses an number of data tables for its calculations, they include:

- Asset Inventory: This table contains detailed asset inventory records documenting all assets used by the nation's transit operators. These records contain each asset's type, mode, owner/agency, age, date of fabrication, acquisition cost, and quantity. These inventory data are derived from NTD data, from agency submissions to FTA asset inventory data requests and from special FTA studies. This table is the primary data source for the data used by TERM's Rehab and Replacement Module.
- UZA Demographics: This table contains demographic data for over three hundred of the nation's largest urbanized areas. For each urban area, the table includes the population level and growth rate, employment level and growth rate, state(s) in which the UZA is located, the population stratum of the UZA, area served (in square miles), current levels of vehicle miles traveled (VMT) levels and projected growth rates, and current levels of transit passenger miles traveled (TPM) in each UZA and the projected TPM growth rates.
- Agencies: This table documents basic characteristics of all public transit systems identified in NTD, including their Name, FTA ID Code, location (city, state, UZA, and FTA region), and the population strata to which they belong. Data in this table are obtained from NTD.
- Agency-Mode Statistics: This table contains detailed agency operations and maintenance statistics by agency-mode. Specific table fields document the level of transit service

consumed and supplied in recent years, and the level of maintenance applied to each agency's asset base (by mode). This table provides crucial input data to (1) estimate which transit agency-modes are candidates for performance improvement investments and (2) support the cost and benefit analysis of future investments in agency-modes (i.e., rehab-replace, expansion and performance improvement). The data in this table come from NTD.

- Asset Types Files: This table identifies all the types of assets owned and operated by the Nation's public transit systems with one record for each type of asset. For each asset type, the table includes data fields for asset unit replacement cost, rehabilitation cost, rehabilitation life expectancy, and acquisition cost inflation factors used to convert asset replacement values to year preceding the twenty year forecast period.
- Benefit-Cost Measures: This table documents the benefits (or cost reductions) associated with increased transit investment. These measures include transit rider values (e.g., value of time and links per trip), auto costs per VMT (congestion delay, emissions costs, and roadway wear), and auto user costs (auto depreciation, insurance, fuel, maintenance and daily parking costs).
- Mode Types: This table provides data on transit operations (average speed, average headway, and average fare) and estimates of typical ridership fare elasticities (i.e., the responsiveness of riders to changes in fares, by transit mode). Similar data are included for non-transit modes (e.g., private auto and taxi costs).

Reference: Transit Economic Requirements Model User's Guide, Federal Transit Administration, Office of Budget and Policy, 2005

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