Commission Briefing Paper 2B-01

2006 C&P Findings: Transit Condition and Performance

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Introduction

This paper is part of a series of briefing papers to be prepared for the National Surface Transportation Policy and Revenue Study Commission authorized in Section 1909 of SAFETEA-LU. The papers are intended to synthesize the state-of-the-practice consensus on the issues that are relevant to the Commission's charge outlined in Section 1909, and will serve as background material in developing the analyses to be presented in the final report of the Commission.

This paper presents information on the characteristics, condition, and performance of the Nation's transit system and its components including vehicles, maintenance facilities, stations, systems and guideway. Is includes data on system use, and asset conditions and operational performance.

Background and Key Findings

The information and findings presented in this paper are extracted from the 2006 *Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance* Report to Congress, and is based on data from 2004. Key findings include:

- Passenger miles traveled on transit (PMT) increased at an average annual rate of 2.3 percent between 1995 and 2004, growing from 38 billion miles in 1995 to 46.5 PMT in 2004.

- The estimated condition of bus vehicles improved between 1995 and 2004, and the average age of bus vehicles declined from 7.3 years to 6.1 years. Bus vehicles are on average in adequate condition.

- Rail vehicle conditions and average ages have been relatively unchanged over the last 10 years, and have been, on average, slightly higher than bus vehicle conditions. The average rail vehicle condition falls into the adequate to good range. In 2004, rail vehicles had an average age of 20 years.

- The average speed of passenger travel on rail decreased from 1995 to 2000 as the capacity utilization of the heavy rail, light rail and commuter rail increased; as the capacity utilization of these rail modes a declined from 2001 to 2003 the average speed of travel on rail increased. As the capacity utilization of heavy rail and commuter rail increased again from 2003 to 2004, the average speed of travel on rail decreased.

- The transit fatality rate declined by nearly 30 percent over the past 10 years, from 0.77 per 100 million passenger miles traveled in 1995 to 0.55 per 100 million passenger miles traveled in 2004.

System Characteristics

Infrastructure

In 2004, 640 transit systems in urbanized areas reported to the National Transit Database (NTD), of which 600 were public agencies. These 640 reporters operated 468 motorbus systems, 14 heavy rail systems, 19 commuter rail systems, and 27 light rail systems, 438 demand response systems, 43 vanpool systems, 17 ferryboat systems, 4 trolleybus systems, 3 automated guideway systems, 3 inclined plane systems, and 3 jitney systems.

In 2004, urban transit systems, excluding special service providers, operated 120,659 vehicles compared with 114,564 vehicles in 2002, an increase of 5.3 percent. The Nation's transit fleet is primarily composed of buses, which in 2004 accounted for 57 percent of all regular service urban transit vehicles. Seventy-one percent of the buses were found in urbanized areas with more than 1 million people. Sixteen percent of regular urban transit vehicles were rail vehicles, of which 99 percent were found in urbanized areas with more than 1 million people. The Nation's urban transit rail fleet consists primarily of heavy rail vehicles, light rail vehicles, self-propelled commuter rail vehicles, commuter rail locomotives, and commuter rail passenger coaches. In 2004, heavy rail vehicles accounted for 57 percent of the Nation's urban transit rail fleet, commuter rail vehicles for 34 percent, and light rail vehicles for 9 percent.

In 2004, there were 793 maintenance facilities for all transit modes in urban areas, compared with 769 in 2002. Transit providers operated 10,892 miles of track and served 2,961 stations.

The Community Transportation Association of American estimated that there were 1,215 rural transit operators in 1997 operating 19,185 vehicles. This is the most recent information available. A new survey is currently underway.

A recent survey by the University of Montana concluded in the spring of 2004, that there were 4,836 private and nonprofit agencies that received FTA federal funding (Section 5310) designated to provide transit services for the elderly and disabled. These providers were estimated to be using 37,720 special service vehicles in 2002, the most recent year for which information is available.

Use

There are two primary measures of transit ridership—unlinked passenger trips and passenger miles traveled (PMT). In 2004, there were 8.9 billion unlinked trips and 46.5 billion PMT reported for urban transit systems to the National Transit Database (NTD). PMT increased at an average annual rate of 2.3 percent between 1995 and 2004, growing from 38 billion miles in 1995. In 2004, 56 percent of unlinked trips were on motorbuses, 31 percent were on heavy rail, 5 percent were on commuter rail, and 4 percent each were on light rail and other. By

comparison, 41 percent of PMT were on motorbus, 31 percent were on heavy rail, 21 percent were on commuter rail, 3 percent were on light rail, and 4 percent were on other.

Physical Condition

Condition Scale

The Federal Transit Administration (FTA) uses a numerical scale ranging from 1 to 5 to describe the condition of transit assets. A rating of 5, or "excellent," is synonymous with no visible defects or nearly new condition; a rating of 4 is "good" with some slightly defective or deteriorated components; and a rating of 3 is "fair" or with moderately defective or deteriorated components; a rating of 2 is "marginal" with defective or deteriorated components, and a rating of 1 is "poor" with seriously damaged components and in need of immediate repair.

Estimation Process

FTA uses the Transit Economic Requirements Model (TERM) to estimate the conditions of transit assets. This model is composed of a database of transit assets and asset decay schedules that express asset conditions principally as a function of an asset's age. Vehicle condition is also based on an estimate of vehicle maintenance history and capital nonreplacement expenditures; the conditions of wayside control systems and track are based on an estimate of use (revenue miles per mile of track) in addition to age. The deterioration schedules for vehicles; maintenance facilities; stations; and train control, electrification, and communication systems have been estimated by FTA using data collected with special on-site engineering surveys. The deterioration schedules for guideway structures and track are based on data collected by a much earlier survey in Chicago. Information on vehicle age, maintenance history, capital non-replacement expenditures and revenue miles per track are based on data from the NTD. Transit vehicle conditions also reflect the most recently available information on vehicle age. All of the other information on transit assets used by TERM has been collected with special data collection efforts.

Bus Vehicles

The estimated condition of bus vehicles improved between 1995 and 2004, and the average age of bus vehicles declined. In 2004, the estimated average condition of the urban bus fleet was 3.08 (in the adequate range) compared with 2.88 in 1995; the average age of the bus vehicle fleet declined from 7.3 to 6.1 years. Since 1995, larger vehicles (articulated, full-size, and mid-size buses) have tended to have, on average, slightly lower-rated conditions than smaller vehicles (small buses, vans). Average bus fleet conditions ranged from 2.30 to 4.40 for the 31 agencies that participated in the most recent FTA bus vehicle conditions assessment.

Bus Maintenance Facilities

FTA estimates that the on average bus maintenance facilities are in adequate to good condition. The average condition of a bus maintenance facility conditions was 3.41 in 2004. In 2004, 17 percent of all urban bus maintenance facilities were in excellent condition in 2004, 5 percent in good condition, 47 percent were in adequate condition, and 31 percent were in substandard or

worse condition. Comparable condition estimates are not available for 1995 due to methodological revisions. In 2004, 10 percent of bus maintenance facilities were less than 10 years old (compared with 21 percent in 1995), 42 percent were 11 to 20 years old (compared with 24 percent in 1995), 24 percent were 21 to 30 years of age (compared with 34 percent in 1995), and 24 percent were 31 years or older (compared with 21 percent in 1995).

Rail Vehicles

Rail vehicle conditions and average ages have been relatively unchanged over the last 10 years, and have stayed on average slightly higher than average than bus vehicle conditions in the adequate to good range. In 2004 average rail vehicle condition was 3.50 and average rail age was 19.7 years, compared with an average condition of 3.48 and average age of 19.1 years in 1995. Changes in ages and conditions of all rail vehicles appear to fall within the range of normal depreciation, rehabilitation, and replacement cycles. Although condition is often correlated with age, it is also correlated with preventive maintenance expenditures and vehicle rehabilitations. For example, in 2004 while 62 percent of commuter rail self-propelled passenger coaches were older than the minimum age required for replacement with Federal funds, their average condition was a fair-to-good 3.69.

Rail Facilities

The average condition of rail facilities was 3.82 in 2004. FTA estimates that in 2004, 26 percent of the Nation's rail facilities were in excellent condition, 17 percent were estimated in good condition, and 7 percent were in substandard condition, and 1 percent were in poor condition. Comparable conditions estimates for 1995 do not exist due to methodological revisions. In 2004, 51 percent of all rail facilities were estimated to be 10 years old or less, 24 percent were estimated to be 10 to 20 years old, 13 percent were estimated to be more than 21 to 30 years old and 13 percent were estimated to be 31 years or older. Age data for 1995 is no longer readily available.

Rail Stations

The average condition of rail stations was 3.37 in 2004. After 10 years of age, light rail stations are, on average, in better condition than heavy rail stations; subway stations are, on average, in better condition than elevated rail stations, and elevated stations, on average, in better condition than at-grade stations. Rail stations 22 years or older turned out to be in much better condition than previously estimated. However, almost half of all rail stations are in unacceptable state with 51 percent estimated to be in substandard or worse condition in 2004. Comparable information on rail station conditions in 1995 does not exist due to methodological revisions.

Rail Systems, Structures, Track and Yards

Rail systems are divided into four categories—communication systems, train control systems, traction power and revenue collection systems—for the purpose of estimating conditions. The estimates of 2004 system conditions, with the exception of those for revenue collection systems, are based on decay curves estimated on data collected from on-site surveys in 2005. These surveys and the reestimated decay curves confirmed earlier estimates that most rail systems are

in adequate or better condition. The percentage of communications systems estimated to be in adequate or better condition was 100 percent in 2004, and the percentage of train control systems estimated to be in adequate or better condition was 74 percent; the percentage of traction power systems estimated to be in adequate or better condition was 99 percent in 2004. Comparable condition estimates do not exist for 1995.

Rural Transit

All rural transit vehicles are buses; rail transit does not serve rural areas. FTA relies on survey data from the Community Transportation Association of America on vehicle ages and maintenance facility conditions. The most current information available was collected from 158 rural operators between June 1997 and June 1999. Rural operators were defined as those operators outside urbanized areas, a different definition than used by the U.S. Census. These surveys found that more than 50 percent of the rural transit fleet was overage. Forty-one percent of small buses, 34 percent of medium-size buses, 27 percent of full-size buses, and 60 percent of vans and other vehicles were found to overage. Small buses more than 7 years old, medium buses more than 10 years old, large buses more than 12 years old, and vans more than 5 years old were categorized as overage. These surveys also found that 30 percent of bus rural maintenance facilities were in excellent condition, 50 percent in good condition, 19 percent in poor condition, and 1 percent in very poor condition.

Operational Performance

The C&P Report measures and evaluates transit performance on a number of different factors--the speed of passenger travel on transit, vehicle occupancy rates and vehicle utilization adjusted for differences in carrying capacities, as well as service frequency and seating availability. These measures do not necessarily all lead towards a single standard of higher operational performance. While higher passenger travel speeds may represent a better level of performance from the passengers' perspective, they may also indicate that transit systems are not carrying enough passengers (and therefore have shorter dwell times). Conversely, while higher vehicle utilization may indicate more intensive vehicle use, it may also indicate that passengers are experiencing crowded conditions, which may in turn lead to lower speeds as the trains spend more time loading and unloading passengers at stations. For this reason, speed, occupancy, and capacity utilization are analyzed only on the basis of the direction of their change; the optimal levels of these measures are unknown.

Speed of Passenger Travel

The speed of passenger travel illustrates how fast a person travels on transit and not the operational speed of a transit vehicle. The average speed of passenger travel on each mode is calculated dividing annual vehicle revenue miles by annual vehicle revenue hours, weighted by the total passenger miles traveled (PMT) for that agency on that mode. The average speed of a transit mode is strongly affected by the number of stops it makes. Motorbus service, which typically makes frequent stops, has a relatively low average speed of 13.6 miles per hour. In contrast, commuter rail has high sustained speeds between infrequent stops, and a high average speed of 32.2 miles per hour. Vanpools also travel at high speeds, usually with only a few stops

at each end of the route, and an average speed of 39.1 mph. Modes using exclusive guideways typically offer more rapid travel time than modes that do not. Heavy rail, which travels entirely on exclusive fixed guideways, has an average speed of 21.0 mph, while light rail, which often shares guideway, has an average speed of 17.7 mph.

The average speed of passenger travel on all rail vehicles combined declined from 26.6 miles per hour in 1995 to 24.9 miles per hour in 2000, increasing to 25.4 miles per hour in 2003 and declining to 25.0 miles per hour in 2004. The average speed passenger travel on nonrail vehicles was 13.7 miles per hour both in 1995 and 2000, increasing to 14.0 miles per hour in 2004.

Vehicle Occupancy

Occupancy levels are calculated by dividing PMT by vehicle revenue miles (VRM) to show the average number of people carried in a transit vehicle at any one time. Heavy rail carried an average of 20 passengers per vehicle in 1995, 24 passengers per vehicle in 2000 and 23 passengers per vehicle in 2004. Commuter rail carried an average 38 passengers per vehicle in 1995 and 2000, and an average of 36 passengers per vehicle in 2004. Light rail carried an average of 25 passengers per vehicle in 1995, an average of 26 passengers per vehicle in 2000, and an average of 24 passengers per vehicle in 2004. Motorbus carried an average of 11 passengers per vehicle in 1995 and 2000, and 10 passengers per vehicle in 2004.

Vehicle Utilization

FTA calculates vehicle utilization by dividing PMT in each mode by the vehicles operated in maximum service in each mode adjusted by the average capacity of the Nation's motorbus fleet. Vehicle utilization, as calculated in this way, is a measure of service effectiveness, taking into account of differences in vehicle carrying capacities. It can also be used to monitor changes in utilization over time, bearing in mind that there may be underlying inconsistencies in seating and standing data reported by transit agencies to the NTD that are used to estimate capacities. For example, FTA has noticed that standing capacities as reported to the NTD have been increasing. It is not clear whether or not this increase is real or whether it reflects changing assessments on the part of transit operators as to how many people can be squeezed into a transit vehicle. Secondly, commuter rail vehicles often do not allow standing and report a standing capacity of zero so that the methodology applied tends to overestimate their utilization. Almost all major modes, except ferryboat, reached their highest level of utilization in 2000 or 2001, and were below their 10-year average utilization in 2004. Overall, the highest utilization levels were reported by commuter rail, in large part because many commuter rail systems do not permit standees. Among modes that permit standing, heavy rail had the highest utilization level of 652 thousand passenger miles per capacity-equivalent vehicle in 2004, followed by light rail with 468 thousand passenger miles per capacity-equivalent vehicle, and motorbus with 373 thousand passenger miles per capacity-equivalent vehicle.

Rail Utilization and Rail Speed

Changes in the utilization of commuter rail, heavy rail and light rail vehicles have had an observable impact on the speed of passenger travel on rail modes through changes in the amount of time the vehicles spend unloading and loading at stations. As the capacity utilization of these

rail vehicles increased between 1995 and 2000 or 2001, the average speeds of travel on rail decreased; and as the capacity utilization of these rail modes declined from 2001 to 2003 the average speeds of travel on rail increased. Between 2003 and 2004, the capacity utilization of heavy rail and commuter rail increased, leading to an overall decrease in average speed of travel during this period.

Service Use

Vehicle service use, the average distance traveled per vehicle in service measures is a measure of transit system performance that provides an indicator for transit systems' return on capital investment. Heavy rail, generally offering long hours of frequent service, had the highest vehicle use over the 1995 to 2004 period. Vehicle use increased noticeably between 1995 and 2000, and increased slightly between 2000 and 2004. Each heavy rail vehicle provided 57 thousand miles per vehicle in 2004 compared to 51 thousand in 1995. Vehicle service use for light rail also increased from 34 thousand miles per vehicle in 1995 to 40 thousand miles per vehicle in 2004; vehicle service use for demand response increased from 16 thousand miles per vehicle in 1995 to 20 thousand miles per vehicle in 2004; and vehicle service use for vanpool increased from 11 thousand miles per vehicle in 1995 to 14 thousand miles per vehicle in 2004.

Service Frequency and Reliability

The frequency of transit service varies considerably according to location and time of day. Transit service is more frequent in urban areas and during rush hours, in locations and during times when the demand for transit is highest. The higher the degree of uncertainty in waiting times, the less attractive transit becomes as a means of transportation, and the fewer users it will attract. Further, the less frequently scheduled service is offered, the more important reliability becomes to users.

The 2001 National Household Travel Survey (NHTS) by the Federal Highway Administration is the most recent nationwide survey of this information. The NHTS found that 49 percent of all passengers who ride transit wait 5 minutes or less and 75 percent wait 10 minutes or less. Nine percent of all passengers wait more than 20 minutes. A number of factors influence passenger wait-times, including the frequency of service, the reliability of service, and passengers' awareness of timetables. Waiting times of 5 minutes or less are clearly associated with good service that is either frequent or reliably provided according to a schedule, or both. Waiting times of 5 to 10 minutes are consistent with adequate levels of service that are both reasonably frequent and generally reliable. Waiting times of 20 minutes or more indicate that service is likely both infrequent and unreliable.

Waiting times are also correlated with incomes. Passengers from households with annual incomes of $30,000 or more are much more likely to report a waiting time of 5 minutes or less than passengers from households with incomes of less than $30,000. Additionally, passengers from households with more than $65,000 in annual income almost never report waiting for more than 15 minutes for transit. This disparity is, in a large part, due to the fact that high income riders tend to be "choice" riders who primarily ride transit on modes, routes, and at times of day when the service is frequent and reliable—and who generally substitute the use of personal automobiles for trips when these conditions aren't met. In contrast, passengers with lower

incomes are more likely to use transit for basic mobility and have more limited alternative means of travel, therefore using transit even when the service is not as frequent or as reliable as they might prefer.

Safety Performance

Transit safety continues to improve. Overall, the transit fatality rate declined by nearly 30 percent over the past 10 years, from 0.77 per 100 million PMT in 1995 to 0.55 per 100 million PMT in 2004. The transit fatality rate includes fatalities to both transit users, and those impacted by the transit system, such as pedestrians struck by busses or light rail vehicles.

Due to a change in reporting definitions, there is no consistent time series information on transit injuries. In 2004, there were 42 transit-related injuries per 100 million PMT requiring immediate transportation away from the scene for medical attention.

CONSOLIDATED COMMENTS FROM MEMBERS OF THE BLUE RIBBON PANEL OF TRANSPORTATION EXPERTS - PAPER 2B-01

One reviewer commented as follows:

- Presents good summary of data from the National Transit Database for most urban rail and urbanized area bus assets covered by the database. For small urban, rural and paratransit, uses information from a survey by Community Transportation Association of America and one by University of Montana on equipment used for elderly/disabled services.

- For operating performance, there are necessarily a variety of calculated gross measures. Measures, data collection and reporting are still significantly evolving. Operating performance for the customer is sensitive to and inversely proportional to utilization of service, so there are competing, mutually exclusive objectives for performance from customer and provider/economic viewpoints, making overall assessment difficult.

- The information on current conditions and performance may not be directly applicable for the Commission's assessment of future needs or even policy. Does give useful information on the "backlog" of needs to bring all rolling stock and facilities up to "good" condition.