Discussion-piece #6
Predicted and Actual Ridership of Proposed New Starts Projects
Federal Transit Administration
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1. Purposes of ridership reviews. FTA periodically compares the actual ridership against the ridership predictions for major transit projects using Federal "New Starts" funds. The analysis has three purposes: (1) to provide an up-to-date picture on the reliability of ridership forecasts as the basis for decisionmaking on proposed New Starts projects; (2) to identify any needed improvements in the technical methods used to make the forecasts; and (3) to identify any appropriate modifications to the way that FTA uses New Starts forecasts in project evaluation.

2. Pickrell report. FTA published the initial review in 1990 in the report *Urban Rail Transit Projects: Forecast Versus Actual Ridership and Cost* (commonly referred to as the Pickrell report after its primary author). That review considered ten projects and found that only one project generated actual ridership that was more than 50 percent of the predicted ridership (specifically, 72 percent) Actual ridership for the other nine projects was less than 50 percent of their forecasts.

3. 2003 report. FTA prepared (but has not yet released) the 2003 report *Predicted and Actual Impacts of New Starts Projects: Capital Cost, Operating Cost and Ridership Data* (hereafter termed the Phase-1 report) to consider the 19 New Starts projects (both rail and bus guideways) that opened for revenue service since the 1990 report. The post-1990 projects showed improvements in the quality of forecasts. Four of the 19 projects generated ridership that was between 70 and 80 percent of their forecasts. Another three projects generated ridership between 80 and 100 percent of their forecasts. And three projects had actual ridership that exceeded their forecasts by modest amounts. Table 1 summarizes the 19 projects, their ridership forecasts, and their actual (or extrapolated) ridership in the forecast year.

4. Pickrell update. The 2003 report also included an updated (year 2000) look at the ten projects reviewed by Pickrell. Two of those ten projects had year-2000 ridership close to forecast levels; two others showed growth since the 1990 report but were still far below forecast levels; three projects had little change in ridership; and three experienced declines in ridership since 1990.

5. Phase-1 conclusions. The 2003 report suggested several possible reasons for the improved quality of transit forecasts post-Pickrell, including greater forecasting experience, more formalized forecasting procedures and guidelines, increased scrutiny of forecasts and the planning process by government agencies and the public, improved forecasting technical methods, and improved computing technology. The report also observed forecasts for people movers, busways, and starter rail lines tended to be least reliable while forecasts for system expansions (additional lines in new corridors or extensions of existing lines in the same corridor) were relatively more reliable.

6. Phase-2. In 2006, further FTA-sponsored analysis of completed projects concluded in the draft report *Predicted and Actual Ridership of New Starts Projects: Detailed Analysis* (not yet released; hereafter the Phase-2 report) undertook detailed reviews of the ridership forecasts for seven of the nineteen Phase-1 projects (as identified in Table 1). This work faced a substantial hurdle in the general unavailability of detailed information on the forecasts themselves. The forecasts were prepared 10 to 20 years ago and supporting documents and data sets (zone-level demographics, trip tables, zone definitions, and coded transit and highway networks) were simply not available. The case studies included two "successful" forecasts that were within ±20 percent of actual ridership and five "less successful" forecasts that were more than twice the actual ridership.

7. Successful forecasts. The two projects with successful forecasts – San Diego El Cajon and Portland Westside – were expansions of existing light rail systems. While it was extremely difficult in a retrospective analysis to confirm the level of quality control and reasonableness checks during the forecasting process, a review of both the calibration and validation tests and the results, as well as transit paths and skims, suggests that these procedures have been more rigorously followed in areas with successful forecasts. To some extent, the success of the two forecasts was the product of offsetting errors. While both forecasts were within ±20 percent of actual project-specific ridership, both missed actual levels of systemwide ridership more than ±20 percent and relied upon corridor-level demographic forecasts that also varied from actual outcomes by more than +/- 20 percent.

8. Less-successful forecasts. The five less-successful forecasts appear to have been subject to multiple types of errors of varying magnitude. Sources of error included erroneous model inputs, problematic model properties, and mistakes in model application – and all forecasts were subject to more than one of these errors.

   - Input errors. The most frequent error involved the magnitude and location of future population and employment growth, a problem in all seven of the case studies, contributing both to the less successful forecasts and the offsetting errors that may have masked other problems in the successful forecasts. Because transit relies heavily on walking for access/egress, errors in demographic forecasts at the regional and/or corridor levels are compounded by incorrect allocations to zones within walking distances of fixed-guideway stations. Other sources of input error include the representation of future-year transportation networks (both highway and transit), inadequate detail in the zone system used to represent the region, as well as prices for transit fares, gasoline, and parking. At least one (and usually more) of these input errors specifically contributed to the forecasting error in each of the "less successful" case studies.

   - Model-property errors. A common problem in the less-successful forecasts was the overestimation of future highway congestion. This problem may be the result of problematic demographic forecasts filtering through the model chain. However, overestimation of highway congestion appeared to occur even where regional trip tables generally replicated actual travel patterns indicated by census journey-to-work information and household surveys. In such cases the culprit is the model set itself, likely problems time-of-day distributions and/or network assignment.

- Model-application errors. Haste in the completion of forecasts to support funding application or environmental documents appears to have led to improper representation of changes in project scope or transit service plans in the travel forecasts. Other changes in scope and service plans have occurred after the forecasts were completed, without a corresponding update in the forecasts. In at least one case the model was validated to an outdated set of observed data before being used for the transit forecasts.

9. Absence of detailed records. While some insights were available from the seven case studies, by far the most significant outcome of the Phase-2 effort was the clear finding that useful comparisons of forecasts with actual outcome are not possible with the largely non-existent records of the forecasts. This outcome has significant implications for the usefulness of the Before-and-After studies that are now a required element of New Starts projects that receive Full Funding Grant Agreements and suggests the need to formalize the preservation of forecasts so that meaningful reviews of their accuracy are possible.

Table 1: Predicted and Actual Ridership for Phase-1 Projects - Forecast Year Comparison

Project	Forecast Year	Forecast Avg Weekday Boardings		Actual (projected) Boardings in Forecast Year	Ratio - Forecast yr actual/Forecast	
		AA/DEIS	FEIS		Actual vs. AA/DEIS	Actual vs. FEIS
Jacksonville ASE	1995	42,472	42,472	2,627(1)	6%	6%
Miami Omni/Brickell	2000	20,404	20,404	4,209	21%	21%
Houston SW Transitway *	2005	27,280	27,280	9,066	33%	33%
Atlanta North Line *	2005	57,120	57,120	21,595	38%	38%
LA Red Line *	2000	295,721	297,733	128,659(1)	44%	43%
Pittsburgh West B'Way	2005	23,369	23,369	10,200(3)	44%	44%
Chicago Orange Line *	2000	118,760	118,760	54,042	46%	46%
San Jose Guadalupe	1990	41,200	41,200	19,738(2)	48%	48%
San Jose Tasman West *	2005	14,875	13,845	9,110	61%	66%
Baltimore LRT Ext.	2005	11,804	12,230	8,207	70%	67%
Baltimore Johns Hopkins	2005	13,600	13,600	10,049	74%	74%
Portland Westside-Hillsboro *	1995/2005	60,314	49,448	49,999	83%	101%
Dallas South Oak Cliff	2005	34,170	34,170	29,307	86%	86%
BART Colma	2000	15,200	15,200	13,482	89%	89%
Salt Lake South LRT	2010	26,500	23,000	25,201	95%	110%
St. Louis Initial System	1995	41,800	37,100	43,711(4)	105%	118%
San Diego El Cajon *	2000	21,600	21,600	23,478	109%	109%
Denver SW LRT	2015	22,000	22,000	23,988(5)	109%	109%
St. Louis St. Clair Ext.	2010	11,960	20,274	16,965	142%	84%
Denver I-25 HOV	2000	not stated	not stated	8,853	NA	NA
Seattle Bus Tunnel	1990	not stated	not stated	44,400	NA	NA

(1) Actual boardings in forecast year given for 2001 since this is the first full year of operation.

(2) Actual boardings in forecast year given for 1992 since this is the first full year after opening

(3) Actual boardings are assumed to increase 1,200 daily riders over 2002 as an additional park and ride lot is completed.

(4) Actual boardings given for 1999 since Airport station did not open until 1998. Forecast year boardings reached by applying the average annual growth in transit boardings achieved by the project sponsor between 1990 and 2002.

(5) Denver has experienced relatively fast ridership growth over the past decade. Since the forecast year remains far in the future, continued growth at recent trends appears overly ambitious. FTA assumed that the Denver project will achieve a growth rate 2/3rds of the growth rate observed between 1990 and 2002. Even at this lower assumed growth rate, this project is very likely to exceed its AA/DEIS forecasts by a significant margin.

* Selected for detailed analysis in the Phase-2 study.

Table 2. Predicted and Actual Ridership for Phase II Case Studies: Summary of Findings by Project

City/Project Name	Summary of Findings
Atlanta MARTA North Line Extension	• 2005 observed boardings only 40% of forecast boardings • Observed rail system ridership less than forecast • Observed overall transit ridership close to forecast but widely fluctuates year-to-year • Forecasting error caused by failure to achieve predicted employment levels in station areas in primary travel market, underestimation of regional employment, fluctuations in overall system ridership, inaccurate transit coding conventions in the model, poor trip distribution model, over-reliance on mode choice adjustment factors, and validation to outdated observed data set.
Chicago CTA Orange Line	• 2000 observed project boardings only 46% of forecast boardings • Observed system-wide rail boardings close to forecast • Observed transit system boardings close to forecast • Forecasting error caused by failure to account for demographic changes in study area / corridor, and poor model structure, especially for trip distribution and mode choice
Houston METRO Southwest Transitway	• 2005 projected (from 2002 observed) boardings only 33% of forecast boardings • Observed transit system ridership less than forecast • Forecasting error caused by failure to achieve predicted population and employment levels in the study corridor and region, failure to achieve predicted land uses in station areas, overestimation of future highway congestion, poor transit coding and zone system, and changes to project following completion of forecasts
Los Angeles MTA Red Line	• 2001 (1st year of full line operation) observed boardings 43% of (2000) forecast boardings • Observed transit system boardings 72% of forecast boardings • Forecasting error caused by poor model inputs for transit fares, gasoline costs, fuel economy, poor transit-access coding, failure to achieve employment forecasts, failure to fully restructure background bus network to eliminate direct competition with line and provide feeder service, service changes due to conversion from trunk line to trunk/branch operations, relocation of line to less attractive transit corridor, and length of time needed to construct and operate full line
Portland Tri-Met Westside/ Hillsboro LRT	• 2002 observed boardings 8% over 2005 predicted boardings • 2001 observed LRT system boardings 3% over 2005 predicted boardings • Forecasting success caused by realistic and quality-controlled transit service inputs, previous experience operating LRT, higher than forecast population/employment growth • Approximately 10% to 15% of the success may be attributed to underestimation of growth • Good model features, such as extra trip purposes, cars per worker variable, use of choice models for demographic inputs, inclusion of non-mechanized trips in mode choice, good model accounting of transit accessibility and use of mode-of-access model in mode choice may have contributed to forecasting success • Errors in population and employment forecasts may have helped ridership forecast for project but are indicative of larger errors in the demographic and employment model (offsetting errors)
San Diego MTDB El Cajon LRT	• 2000 observed boardings 9% over 2000 predicted boardings • 2000 observed LRT system boardings 57% over 2000 predicted boardings • 2000 observed transit system boardings 2% over 2000 predicted boardings • Forecasting success caused by realistic model inputs and quality control, good model features, and greater than expected population and employment growth in the corridor • Approximately 15% to 20% of the success may be attributed to underestimation of growth • Errors in population and employment forecasts may have helped ridership forecast for project but are indicative of larger errors in the demographic and employment model (offsetting errors) • Large forecasting error for LRT system overall suggests problems with mode choice model
San Jose VTA Tasman West LRT	• 2005 observed boardings only 25% of 2005 predicted boardings • Forecasting error caused by severe economic contraction in corridor and surrounding region, overestimation of highway congestion, poor TAZ system, unrefined trip distribution model, poor network inputs, and poor transit assignment