

Before and After Studies of New Starts Projects

Report to Congress

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1 Introduction

The 1993 Government Performance and Results Act (GPRA) requires that Federal agencies improve the effectiveness of their programs and their accountability to the public by focusing on results, service quality, and customer satisfaction. The Act further requires that Federal agencies improve program management and congressional decision-making by assembling objective information about program results and achievement of statutory objectives. As part of its program to implement the GPRA, the Federal Transit Administration (FTA) included in the Final Rule on Major Capital Investment Projects (New Starts, 49 CFR Part 611) (published on December 7, 2000, effective April 7, 2001) several provisions that integrated Before and After Studies into the New Starts project development process. Section 611.7(c)(4) of the Final Rule requires that the sponsor of a New Starts project develop, early in Final Design, a plan to identify the impacts of the project and to examine the accuracy of forecasts for the project. Section 611.7(d) (7) made agreement on the plan between FTA and the sponsor a condition of a Full Funding Grant Agreement (FFGA) (or by extension, a Project Construction Grant Agreement (PCGA))¹ for the project. An FFGA (or PCGA, by extension) executed after April 7, 2001 therefore included completion of the study according to the agreed-upon plan as a requirement of the New Starts grant for the project.

1.1 Statutory Requirements

Title III – Public Transportation of the “SAFE, ACCOUNTABLE, FLEXIBLE, EFFICIENT TRANSPORTATION EQUITY ACT: A LEGACY FOR USERS” (SAFETEA-LU) amended Section 5309 (g)(2)(C) of title 49, United States Code, to codify the requirement for applicants for an FFGA to prepare Before and After Studies.

- (i) IN GENERAL.—A full funding grant agreement under this paragraph shall require the applicant to conduct a study that—
 - (I) describes and analyzes the impacts of the new fixed guideway capital project on transit services and transit ridership;
 - (II) evaluates the consistency of predicted and actual project characteristics and performance; and
 - (III) identifies sources of differences between predicted and actual outcomes.

The Act also requires the development and submission of the plan for collection of data for the Before and After Studies and for analysis of the collected data.

- (ii) INFORMATION COLLECTION AND ANALYSIS PLAN.—
 - (I) SUBMISSION OF PLAN.—Applicants seeking an agreement under this paragraph shall submit a complete plan for the collection and analysis of information to identify the impacts of the new fixed guideway capital project and the accuracy of the forecasts prepared during the development of the project. Preparation of this plan shall be included in the full funding grant agreement as an eligible activity.

¹ The Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) created a new Small Starts Category using Project Construction Grant Agreements (PCGA) in place of Full Funding Grant Agreements for smaller new fixed guideway system and extension projects. While the December 7, 2000, regulation was issued before PCGAs were contemplated, FTA has required that Small Starts projects, and hence, PCGAs include Before and After Studies.

- (II) CONTENTS OF PLAN.—The plan submitted under subclause (I) shall provide for—
- (aa) the collection of data on the current transit system regarding transit service levels and ridership patterns, including origins and destinations, access modes, trip purposes, and rider characteristics;
 - (bb) documentation of the predicted scope, service levels, capital costs, operating costs, and ridership of the project;
 - (cc) collection of data on the transit system 2 years after the opening of the new fixed guideway capital project, including analogous information on transit service levels and ridership patterns and information on the as-built scope and capital costs of the project; and
 - (dd) analysis of the consistency of predicted project characteristics with the after data.

The SAFETEA-LU amendment to section 5309(1)(2) requires that FTA submit a summary of the results of Before and After Studies to committees of the Congress prior to the first Monday of August each year.

FTA issued guidance on Preservation of Information for Before and After Studies on May 16, 2006. This guidance is available at the following website:

http://www.fta.dot.gov/planning/newstarts/planning_environment_5203.html#2_Preservation_of_Information_for_Before_and_After_Study

2 Approach to Before and After Studies

In addition to meeting the legislative requirements, FTA intends for the Before and After Study to benefit the larger transit community through the dissemination of study results and findings. In that vein, the Before and After Study requirement has two other distinct and important purposes:

- (1) To expand insights into the costs and impacts of major transit investments.
- (2) To improve the technical methods and procedures used in the planning, design and construction of those transit projects.

To accomplish the first purpose, each study is to identify the actual costs of the New Starts or Small Starts project and its impacts on transit service and ridership. The study isolates these actual costs and impacts by comparing the conditions that prevail after project implementation to the conditions that existed before implementation.

To accomplish the second purpose, each study examines the accuracy of predicted costs and impacts and conducts analyses to identify the probable sources of differences between forecasted and achieved values. The study determines the accuracy of the predictions by comparing the conditions that prevail after project implementation to the costs and impacts predicted for the project in each phase of the planning and project development process.

Before and After Studies address both purposes through a careful technical analysis undertaken by sponsoring transit agencies in cooperation with other local planning entities and FTA. This arrangement ensures authorship by local agency staff with first-hand knowledge of the project and its development, buy in of individual project sponsors and the broader transit industry, and consistency with national standards for the analysis.

FTA believes that Before and After Studies of all future FFGAs and PCGAs (as well as FFGA and PCGA amendments) will provide an invaluable repository of information and experience that will benefit the entire transit industry. Specifically, information derived from Before and After Studies will provide the following benefits:

- Strengthen the New Starts and Small Starts programs by highlighting the successes of individual transit capital investments and the important role that transit plays in improving mobility and the quality of life in communities throughout the Nation.
- Identify and transfer lessons learned in planning, implementing, and operating transit fixed guideway investments to agencies planning similar projects. Information generated from the Before and After Studies will enable the sponsors of future New and Small Starts projects to build upon recipients' experiences with past projects, including design and operational features that have proven successful, while avoiding options that have been less successful.
- Identify the strengths and weaknesses in local procedures for predicting transit ridership and estimating capital and operating and maintenance costs, and identify ways that technical methods can be improved to support decision-making for future projects.
- Imbed within the planning and project development process the data assembly and analysis tasks that measure predicted and actualized project costs and impacts.
- Accumulate a source of technical information on the actual costs and performance of major transit investments.

The costs of undertaking the Before and After Study, including the collection of data on the current system before the beginning of project construction, are expenses eligible for reimbursement with Federal New Starts funds and are included in the baseline cost estimate (BCE) of the FFGA or PCGA, as applicable. Consequently, agencies undertaking the study will benefit from Federal financial participation in a comprehensive data collection effort that will also be useful for a wide array of local transit planning and performance monitoring activities.

Ultimately, the information derived from Before and After Studies will help to ensure that procedures and technical methods provide reliable information for decisionmaking for new fixed guideway projects. The information will also enable FTA to document the accomplishments of the New Starts and Small Starts programs and strengthen its technical support program.

3 Review of Before and After Studies Completed in the Last Year

This is the third Before and After Studies Report to Congress. It discusses two draft Before and After Studies received by the FTA since the last report. Both project sponsors were required to complete a Before and After Study due to an amended FFGA; the original FFGA was signed prior to the Before and After Study requirement.

3.1.1 TriMet – Interstate MAX Light Rail Project

The Tri-County Metropolitan Transportation District of Oregon (TriMet) and FTA signed an FFGA in September 2000 for the 5.8 mile Interstate Metropolitan Area Express (MAX) light rail transit (LRT) project in the Portland, Oregon region. TriMet was able to realize cost savings

during the project's construction and requested that the savings be used for the purchase of seven additional light rail vehicles. An amended FFGA was signed in November 2004, which allowed TriMet to purchase the vehicles and also required that TriMet conduct a Before and After Study. However, because the amended FFGA took place near the end of construction, TriMet had not developed a Before and After Study plan during project development and had not archived cost estimates and ridership forecasts during planning and project development to the extent that is now required of New Starts project sponsors.

3.1.2 Project Background

Planning began in 1982 for the Interstate MAX LRT when a North-South line was identified as a priority project in the Regional Transportation Plan. In 1991, two preliminary Alternatives Analysis studies were initiated. The goals of the respective studies were to evaluate and identify a north and south priority corridor. In addition, these studies explored whether the north corridor project would be developed simultaneously or following the south corridor's project development. In 1993, the Metro Council, the regional governmental agency for the Oregon portion of the Portland metropolitan area, and the Clark County [Washington] Public Transportation Benefit Area Authority (C-TRAN) Board of Directors selected the Milwaukie corridor as the South Priority Corridor and the I-5 North Corridor as the North Priority Corridor. These corridors were consolidated into one project and advanced into a Federal Alternatives Analysis. However, in 1994, FTA replaced the Alternatives Analysis with the Major Investment Study (MIS) as a way to examine the alternatives of a project prior to entry into Preliminary Engineering. Thus, in November 1994, the Metro Council adopted the MIS Final Report, which documented the locally preferred strategy for the South/North corridor. FTA approved this MIS in 1996 and accepted the South/North Corridor project into Preliminary Engineering in April 1996.

In February 1998, the Draft Environmental Impact Statement (DEIS) was completed, and in July 1998, a locally preferred strategy was selected. However, in November 1998, voters defeated a local funding ballot measure that would have re-approved the local funding match for the project. In order to respond to reduced funding, the project was reworked into a shorter 5.8 mile LRT line extending northbound from the Rose Center along Interstate Avenue. Subsequently, a Supplemental Draft Environmental Impact Statement (SDEIS) was prepared, and this 5.8 mile LRT line was adopted as the new locally preferred strategy in June 1999. Upon completion of the Final Environmental Impact Statement (FEIS) and other project milestones, the environmental Record of Decision was issued in January 2000, and FTA approved the project into Final Design the following month. An FFGA was signed in September 2000, with an anticipated revenue operations date of September 30, 2004. Due to innovative construction techniques the project opened for revenue service on May 3, 2004 (4 months ahead of schedule).

3.1.3 Report Findings

FTA received the draft Before and After Study Report from TriMet (the project sponsor) in November 2007. While several items still need clarification, the available information offers a good opportunity to compare the sponsor's predictions against actual "after" data.

Capital Costs

Actual project costs were \$350 million in year of expenditure (YOE) dollars, which is the same as the FFGA estimate. While some cost categories went up and others went down (with the \$34.7 million FFGA allocation for contingencies fully utilized), this represents good overall project engineering that may have been influenced by previous light rail construction experience in the Portland Metropolitan Area.

One objective of FTA's before and after requirement is to compare actual costs to the predictions available when local planning decisions were being made (e.g., during identification of the Locally Preferred Alternative from the Alternatives Analysis). However, the earliest predictions for a project similar in scope to the Interstate MAX go back to the SDEIS published in 1999. The total cost at that time was estimated as \$282.9 million in YOE dollars, which means the actual \$350 million cost was 24 percent (\$67.1 million) over the prediction. The major reasons for the cost overrun include the following:

- Reporting instructions changed between the two timelines, representing \$11.3 million for start-up and interim financing in final costs that weren't reported in the SDEIS.
- The number of vehicles purchased was increased.
- Increased costs for communications and signals.
- Increased costs for rebuilding rather than modifying a bridge.
- Increased costs for right-of-way associated with the number of easements required for implementation.

Ridership

Observed ridership for the Interstate MAX was 11,800 passengers per weekday in the opening year (2005), compared to a 2005 model-based prediction of 13,900 riders for the FEIS published in 1999. [Note: opening-year predictions for the constructed project were not available from the earlier Alternatives Analysis and DEIS]. While actual 2005 ridership was 15 percent less than predicted, the MAX has since attracted more riders (13,600 average weekday riders in May 2007). A more detailed examination of the 2005 predicted-versus-actual information show that even with the good overall comparison, there are still areas for future travel model improvement:

- The actual number of jobs in the corridor was 27 percent less than predicted.
- The travel model output shows that 53 percent of all rail riders were commuters, whereas the results of a transit on-board survey indicate only 40 percent were commuters.
- The park-and-ride modeling assumptions were overly optimistic.
- Predicted rail speeds were 8 percent higher than actual.
- Some transfer and walk connection assumptions were overly optimistic.

3.2 Puerto Rico Highway and Transportation Authority– Tren Urbano Heavy Rail Project

The Puerto Rico Highway and Transportation Authority (PRHTA), the project sponsor, and FTA signed an FFGA in March 1996 for the 10.7 mile double track heavy rail system, for a total project cost of \$1.25 billion and a revenue operating date set at July 1, 2001. An amended FFGA

was signed in July 1999 for a revised total project cost of \$1.676 billion, which increased the number of stations by two for a total of 16 and the number of rail vehicles by 10 for a total of 74, with an anticipated revenue operations date of May 2002. From 1999 to 2004, the total estimated project cost increased from \$1.654 billion to \$2.250 billion. Thus, in 2000 amid concerns about schedule, costs and project management, FTA and the Department of Transportation's Office of Inspector General (OIG) required PRHTA to submit a cost recovery plan. However, as of 2004, FTA and the OIG had not been able to approve the cost recovery plan, causing PRHTA to absorb the rise in construction costs locally. Consequently, no additional Federal funds were obligated after the 1999 FFGA amendment. In May 2002, FTA approved an extension of the revenue operations date to June 30, 2004. The project opened for limited revenue operations in December 17, 2004, with full revenue operations achieved June 6, 2005 (4 years behind the original schedule).

3.2.1 Project Background

Rail transit has been considered in the San Juan region since 1967 when a 27-mile, two-route heavy rail system was proposed in the Regional Transportation Study. A feasibility study conducted in 1979 proposed a one-line 14-mile heavy rail alternative that incorporated aerial structures, underground and at grade segments into a route that traversed from Miramar to Bayamon, dubbed the "Bayamon Crescent." This project was approved into the Regional Transportation Plan in 1982. Almost a decade later, a 31-mile light rail system was again proposed with a 7.4-mile initial segment to be constructed from Old San Juan to Rio Piedras. This system, particularly the initial segment, was designed to replace existing bus service and would run at grade in an existing right-of-way. FTA and the Department of Transportation and Public Works decided in 1993 that the work performed in support of the 1979 feasibility study could be submitted as an Alternatives Analysis and, therefore, the project was allowed to enter the New Starts pipeline. To reduce costs, the alignment eliminated the underground segment and was reduced in length from 14 miles to approximately 10 miles running from Santurce to Bayamon. The total construction cost was estimated to be \$670 million (in 1992 dollars), excluding the purchase of right-of-way.

3.2.2 Report Findings

FTA received the draft Before and After Study Report from the project sponsor in March 2008. While the draft report is missing important information to adequately describe the reasons for the significant over-prediction of rail ridership, there is, nevertheless, sufficient information to determine the most-likely causes.

Capital Costs

Since the 1996 FFGA was awarded before the requirement for Before and After Studies was in place, many important elements were not subject to data collection or extensive documentation at the time the project was initiated. Although the intent of FTA's requirements are to compare actual costs to the predictions available when local planning decisions were being made, the earliest "predicted" for this summary represents the 1996 FFGA.

The report notes that contracts are still in litigation with the expected outcome being a financial settlement either by court imposition or a negotiated settlement by the various parties. No Federal funds are involved in the settlement of these lawsuits, but resolution will enable closeout of all contracts and the final calculation of project costs. The current estimate of actual costs is \$2.250 billion in YOE dollars, which is 80 percent higher than the Baseline Cost Estimate for the 1996 FFGA of \$1.250 billion. The major reasons for this significant overrun include the following:

- Contractor bids were higher than the original estimates.
- As design progressed, the following changes were made in several of the project characteristics/scope:
 - Exercise contract options for two additional stations.
 - Exercise contract options for adding ten vehicles.
 - Also changes were made to reflect the unforeseen site conditions and refinements to the scope of the project.
- Project delays due to the following:
 - Lack of qualified construction personnel.
 - Weather conditions (starting in mid-1999 there were three hurricanes).
 - Interface coordination issues.
 - Design changes while construction was underway.
- The extended schedule and delays required additional support from the Project Management and Construction Management services consultants as well as additional in-house administrative support.
- Increased right-of-way costs.
- Settlement agreements--all contractors requested additional time and money due to weather, complexity of the project, numerous interface coordination issues, and evolving design control while construction was underway.
- Acceleration payments for contract completion given to several contractors.

Ridership

While actual project costs were significantly higher than the original predicted costs, the actual transit ridership was significantly lower than the travel model-based predictions:

- Observed ridership was 24,700 average weekday rail passengers in Year 1 (2005-2006) and 26,900 in Year 2 (2006-2007).
- Predictions for the 1996 FFGA were 114,500 weekday rail passengers in 2010 (ten years after the expected 2001 opening).
- Predictions for the 1999 FFGA (with a project change from 14 to 16 stations, plus changes to the surrounding bus network) were 82,000 weekday rail passengers in 2001 and 113,100 in 2010.

The observed average weekday rail ridership in Year 2 of operations was 23 percent of the prediction made for the 1996 FFGA. A forensic analysis involving a review of travel model specifications and network/demographic inputs, plus additional model tests, is needed to track down the share of contributions of the major drivers for such a significant over-prediction of ridership. The ridership errors appear to be due to a combination of the following factors:

- The travel model specifications may have been too favorable for use of rail over auto and bus choices.
- The assumed flat fare for riding Tren Urbano was significantly less than the actual implemented fare.
- The coded transit network did not adequately represent the private and public bus services that offered the public a competitive alternative to use of rail.
- The predicted end-to-end rail travel times were lower than actual.
- The model over-estimated the amount of intermodal integration that actually occurred at the rail stations (e.g., the model predicted more than 50 percent of all rail riders will arrive at a station by bus rather than walking or driving, but survey data shows the actual number is less than 20 percent).
- In spite of the model's over-prediction of total rail riders, it under-predicted the number of park-and-ride and kiss-and-ride users--which may have influenced the construction of an insufficient number of parking spaces to satisfy actual park-and-ride demand.
- Population was assumed to grow by 19 percent from 1990 to 2010, but Census data for the 1990-to-2010 periods shows a growth of only 5.4 percent.

4 Conclusions

TriMet and PRHTA conducted good faith efforts to produce reports that, in some cases, involved collection of data that was not fully archived in the original planning process. This reinforces the need for FTA to work with project sponsors during the planning process to ensure sufficient information has been preserved to conduct a comprehensive Before and After Study.

The two draft Before and After Studies submitted this year offer a wealth of information and the opportunity to improve data collection and analysis of major capital transit investments. The preliminary findings for both the Interstate MAX Light Rail and the Tren Urbano Heavy Rail projects show the actual capital costs were higher than the predicted costs, while the actual ridership was lower than the predicted ridership. The predicted cost and ridership for the Interstate MAX may have come a lot closer to the actual due to the previous experience in the Portland, Oregon region with construction and operation of a light rail system. In addition to lack of experience in Puerto Rico with heavy rail systems that may have impacted the large errors in both the cost and ridership forecasts, the significant over-prediction of Tren Urbano ridership seems to be due to errors in accurately representing the actual transit system that existed after the rail project was opened for revenue operations.

FTA anticipates the final Before and After Studies for the Interstate MAX Light Rail and the Tren Urbano Heavy Rail projects will be completed during the current year and the final results will be presented in the August 2009 Before and After Study Report to Congress, if there is additional relevant information. The next Before and After Study is not anticipated until May 2010, when the Charlotte Area Transit System is expected to submit a report on the South Corridor LRT project that opened for revenue service in November 2007.