Destinations Matter: Building Transit Success

White Paper

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Prepared by

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16. Abstract (Limit: 200 words)

This paper looks to assess the importance of linking major destinations with transit service and the accuracy of predictive computer models used as a basis for funding decisions in recently opened transit lines. Decision makers at all levels of government pay close attention to the effectiveness of public investments in transit and local decision-makers and the public, who are providing significant matching funds for transit projects, also want to see funds used wisely and effectively. As a result, accurately estimating the potential ridership and economic development benefits from proposed transit investments is important. And, with a renewed public interest in transit as an important transportation option, ensuring that the capacity of transit matches demand is also a key strategy.

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Notice

Summary

This paper looks to assess the importance of linking major destinations with transit service and the accuracy of predictive computer models used as a basis for funding decisions in recently opened transit lines. Decision makers at all levels of government pay close attention to the effectiveness of public investments in transit and local decision-makers and the public, who are providing significant matching funds for transit projects, also want to see funds used wisely and effectively. As a result, accurately estimating the potential ridership and economic development benefits from proposed transit investments is important. And, with a renewed public interest in transit as an important transportation option, ensuring that the capacity of transit matches demand is also a key strategy.

Since ridership is one of several factors that are used to judge the effectiveness of a proposed new line, and many communities are seeking to build more transit lines, it is increasingly important that predictive models are as sensitive as possible to the conditions that either boost or slow transit ridership. It must also be noted that while ridership is important, it should not be the ultimate determinant in whether a regional transit line gets built. This white paper analyzes the performance of recent transit investments and presents an analysis of factors that may cause certain lines to perform differently than current models would predict. As the title suggests, transit corridors that link multiple regional destinations and housing opportunities also appear critical to achieving promised ridership and economic returns. This paper also suggests that a more fine tuned analysis of the role of linking destinations is important to better understand the variables that may increase or dampen potential ridership.

Introduction

Why Do Destinations Matter?

Decision makers at all levels of government pay close attention to the effectiveness of public investments in transit. Congress requires the Federal Transit Administration (FTA) to report both on its evaluation and rating recommendations for proposed new Federal transit capital investments (called New Starts and more recently a Small Starts program[1]), and on the performance of contractors to develop accurate ridership estimates.[2] Local decision-makers and the public, who are providing significant matching funds for transit projects, also want to see funds used wisely and effectively. As a result, accurately estimating the potential ridership and economic development benefits from proposed transit investments is important. And, with a renewed public interest in transit as an important transportation option, ensuring that the capacity of transit matches demand is also key.

The good news is that data suggests that the a majority of recent rail lines built with Federal funding through the New Starts program are performing at least as well as pre-construction projections. Some lines are even outperforming their future ridership estimates and in certain cases far ahead of projections. The bad news is that when transit exceeds expectations, local transit providers and cities are often unprepared for success.

Over performing lines help demonstrate the appeal of transit service and give transit agencies and communities momentum and political capital to expand their systems to benefit more of the region. At the same time though, over-performing lines can create capacity strains, such as a shortage of transit vehicles, parking spaces or maintenance facilities. Underperforming lines can lead to less confidence in the transit agency and reluctance by the public to make additional regional transit investments. Reliable ridership modeling is critical to both maintaining public support for future transit projects and in accurately estimating capacity needs.

Since ridership is one of several factors that are used to judge the effectiveness of a proposed new line, and many communities are seeking to build more transit lines, it is increasingly important that predictive models are as sensitive as possible to the conditions that either boost or slow transit ridership. It must also be noted that while ridership is important, it should not be the ultimate determinant in whether a regional transit line gets built. This white paper analyzes the performance of recent transit investments and presents an analysis of factors that may cause certain lines to perform differently than current models would predict. Land use and economic development are among those factors evaluated by the FTA in its New Starts review process. As the title suggests, transit corridors that link multiple regional destinations and housing opportunities also appear critical to achieving promised ridership and economic returns. This

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[1] The Small Starts program was introduced in Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) and funds fixed rail and bus rapid transit projects seeking under $75 million in federal funds.

[2] The *Contractor Performance Assessment Report* was released in September 2007 by the FTA and includes an analysis of ridership estimates and performance of 2003 predicted versus actual ridership data. As noted in the report, "Section 5309 of Title 49 of the United States Code, as amended by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU), emphasizes the need to improve the quality of the estimates of ridership and costs used to support funding decisions for major transit investments. To help fulfill this goal, FTA is required to submit an annual report to Congress that documents and analyzes the performance of contractors that develop cost and ridership estimates to support decision-making for New Starts and Small Starts projects. The SAFETEA-LU Conference Report indicates that the Contractor Performance Assessment Report (CPAR) "will provide public transportation agencies with an informational tool, allowing them to better identify contractors able to perform accurate estimates of cost and ridership figures. Additionally, consulting the CPAR as a condition of Federal assistance will help ensure the reliability of estimates used in awarding FFGAs."

paper also suggests that a more fine tuned analysis of the role of linking destinations is important to better understand the variables that may increase or dampen potential ridership.

Methodology

This paper looks to assess the importance of linking major employment destinations with transit service and the accuracy of predictive computer models used as a basis for funding decisions in recently opened transit lines. In the following pages, we have chosen to examine eight light rail lines that have opened between 2003 and 2006. These specific lines were chosen for more in depth study because they were similar to each other, such as transit technology and route distance, and have not been studied extensively before. While there have been 24 light rail lines built in the past 5 years, the term "light rail" has come to represent a multitude of operational types including streetcars and diesel multiple unit (DMU) service on existing freight corridors. Therefore we chose lines where it was possible to compare alignments, used similar technology and operations, and that had been open for over one year. Because a number of recently built projects have been implemented without federal funding, we chose to study not only lines with federal funding, but some that were entirely locally funded. The purpose of this was to see if projects faced similar or different results in any funding environment.

Predictive estimates of ridership for all 24 lines were collected from documentation of the final year that a project was in the New Starts pipeline or from the sponsoring agency[3]. Current ridership numbers were gathered from a variety of sources, including the National Transit Database (NTD) and individual sponsoring agencies. We found that some agencies are better than others at making data available on a corridor basis, and comparing ridership before and after opening is difficult due to the fact that agencies report to the NTD based on system ridership instead of ridership on individual lines. To the extent that data was collected from the NTD, it was for cities which only had one line such as in Houston or Minneapolis; other cities, such as San Jose, do not break out ridership by constructed segment and were reluctant to share station counts, making before and after estimates of ridership practically impossible. There is also an emerging problem of agencies citing national security concerns as a reason to not release ridership counts at individual stations.

Information from agencies about modeling and land use considerations was gathered through telephone and email interviews conducted with planners and interested parties inside and outside of each agency whose line is studied. Jobs calculations were made by taking job tallies from the LEHD OTM data provided by Cornell University and connecting them with census blocks in GIS. A half mile was then cut around each station in each region studied and the jobs were tallied as a corridor.[4]

Analysis of Selected New Transit Lines

FTA is required under Federal law to implement a thorough review process and rate proposed transit projects seeking Section 5309 federal New Start and Small Start funding. While Congress specifies an

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[3] If the project was involved in the federal funding process, the predictive ridership estimates were gathered for the year immediately before receiving a Full Funding Grant Agreement. If the project was not seeking federal funds, the ridership estimates were gathered from the sponsoring agency.

[4] The VirtualRDC warns that job tally should be made at the census tract or greater, even though the data is given at the block level. We believe that the corridor is a big enough geography to aggregate to. This however is a different approach than we normally take with the census, since there we recalculate cut off block groups. This estimate should be taken as an estimate and not as an absolute number. However it does work for the purposes of this document to show the basic relationship between jobs and transit ridership. To learn more about LEHD Data, please visit the VirtualRDC Website and the Census LED site: http://www.vrdc.cornell.edu/news/ or http://lehd.did.census.gov/led/

extensive list of factors to be evaluated, FTA develops the regulations and process for the evaluation framework. A significant portion of the evaluation is based upon locally-prepared ridership forecasts that feed into several different evaluation elements used by FTA. One of the primary evaluation measures is the Transit System User Benefit (TSUB) calculation, initiated in 2003 as a primary tool for calculating the cost effectiveness of potential new transit lines. FTA's 2007 Contractor Assessment Report includes analysis of 21 New Starts projects that opened for revenue service between 1990 and 2002, prior to the implementation of TSUB. This paper provides a preliminary analysis of several more recently opened lines that have undergone the post-2003 FTA analytical framework.

Between 2003 and 2007, approximately 24 new light rail lines and extensions have begun operation, including projects built without Federal New Starts funding (see Table 1). This paper focuses on eight lines representing a variety of new transit investments from around the country, including a mix of federally and locally funded projects. Six of the lines analyzed in greater depth in this paper have been through or started the FTA New Starts evaluation process, while two have built their extensions outside that process.

Table 1. Newly Opened Transit Lines, 2003-2007

City	Line	Transit Authority	Year**	Expansion or Initial Line	Tech
Los Angeles	Gold Line Phase I	LACMTA	2003	Expansion	LRT
Sacramento**	South Corridor LRT Phase I	Sac RT	2003	Expansion	LRT
Salt Lake City*	Medical Center Extension	UTA	2003	Expansion	LRT
Tacoma	Tacoma Link	Sound Transit	2003	Initial	Streetcar
St. Louis*	St. Clair Extension	St. Louis Metro Transit	2003	Expansion	LRT
Tampa*	TECO Line	HART/ City of Tampa	2003	Initial	Streetcar
Houston	Main Street Metrorail	Houston Metro	2004	Initial	LRT
Memphis*	Medical Center Expansion	MATA	2004	Expansion	Streetcar
Minneapolis*	Hiawatha Line	Metro Transit	2004	Initial	LRT
New Jersey	Camden-Trenton River Line	New Jersey Transit	2004	Initial	DMU-LRT
Portland*	Yellow Line/Interstate	Tri-Met	2004	Expansion	LRT
San Jose	Tasman East Extension	VTA	2004	Expansion	LRT
Little Rock*	River Rail	CATA	2004	Initial	Streetcar
San Diego*	Green Line	SANDAG	2005	Expansion	LRT
San Jose	Vasona Extension	VTA	2005	Expansion	LRT
Denver*	Southeast Corridor	RTD	2006	Expansion	LRT
New Jersey	Newark Rail Link MOS1	New Jersey Transit	2006	Initial	LRT
New Jersey*	Hudson Bergen Line MOS2	New Jersey Transit	2006	Expansion	LRT
Sacramento	Folsom to Amtrak Extension	Sac RT	2006	Expansion	LRT
St. Louis	Cross County	St. Louis Metro Transit	2006	Expansion	LRT
Portland	Streetcar Expansion	Tri-Met/City of Portland	2007	Expansion	Streetcar
San Francisco	3rd Street Light Rail/Mos1	SF MUNI	2007	Expansion	LRT
Charlotte*	South Corridor	CATS	2007	Initial	LRT
Seattle	South Lake Union Streetcar	King County Metro	2007	Initial	Streetcar

* Supported with partial funding from the FTA

**Opening year of the most recent segment

Source: CTOD, 2007.

Lines were chosen to be studied in greater detail based on their ridership numbers and available data. As stated previously in the methodology section, the lines that were chosen are also similar in operations characteristics and vehicle technology and have had over a year of operations to qualify their ridership numbers. Several lines were left out that might have been interesting to look at including the San Jose Vasona extension and the Hudson Bergen line expansion however accurate specific line ridership information was difficult to acquire. Other lines were not studied in more detail because they were streetcar circulators, short extensions of existing lines, or DMU operations. The intent was to assess whether the built environment plays a key role in otherwise similar transit lines. Many cities without existing rail lines look to these lines specifically as models for their possible futures.

Line Profiles

Each of the eight new transit lines selected for more detailed study has been touted as a success story in some way. Some have reached their long-term ridership goals early, while others have not. The selected lines represent a mix of factors important to considering transit performance:

- Whether or not the line is an extension or an introduction of fixed-guideway service;
- The degree to which land use and development policies were explicitly linked to the transit investment; and,
- The extent to which major destinations such as retail, employment or educational centers were purposefully linked or developed along the corridor to take advantage of a higher level of transit service.

We compare a combination of lines that went through the Federal review process and others that sought non-Federal funds. Following is a short synopsis of each line discussed in this paper.

Houston, Texas – Metro Red Line

In January of 2004, just days before hosting Super Bowl XXXVIII, Houston opened its first light rail line. The 7.5 mile line was constructed exclusively using local funds and in the Fourth Quarter of 2007 it carried 40,000 riders a day[5], well ahead of the projected ridership estimates of 18,000-20,000 passengers per day.[6] The line began the Federal New Starts process, but left after a local decision to not seek Federal funding after congressional opposition. It was hoped that this particular project could be used as a match for later projects. The alignment has exclusive lanes in the street median and runs on six-minute headways during peak hours and 12 minutes off-peak. The line runs down Houston's Main Street and connects the world's largest medical center to the downtown area and includes stops at three sports stadiums, museums, and the zoo district along the alignment, Roughly 245,000 jobs are located within walking distance of the light rail line.

San Diego, California – Green Line

In July of 2005, San Diego opened its fourth light rail extension, dubbed the Mission Valley East or Green Line. The 5.9 mile extension is entirely grade-separated and connects the suburban ends of two existing lines to make a loop outside the central city. Approximately 150,000 jobs are projected for the corridor by 2015. The Green Line also includes the first subway station in the San Diego system at San Diego State University. The grade separation, while adding considerable project cost, has resulted in faster travel times for commuters. In September of 2007 over 26,923 people rode the line.[7] The line went

[5] APTA NTD Ridership Accessed 8 May 2008. <http://www.apta.com/research/stats/ridership/riderep/documents/07q4lr.pdf>

[6] Todd Mason. Houston Metro. Vice President of Real Estate Services. Phone Interview 17 September 2007

[7] September Trolley Ridership Report. SANDAG. Received 8 October 2007. (See Appendix)

through the Federal New Starts process and 65 percent of the project cost came from Federal funds. San Diego has taken ambitious steps to promote transit-oriented development around the stations in its system. The local transit agency has adopted strong joint development policies, limits parking within TOD zones and has issued TOD guidance documents. Despite a required transfer to reach downtown destinations, the line has produced more downtown transfers to the blue line than expected and allows suburban commuters to travel to destinations along the blue and orange lines without having to route through the downtown.

Minneapolis, Minnesota – Hiawatha Line

Hiawatha Avenue was initially planned as a freeway in the 1960's and an expressway in the 1980's with a reserved right-of-way for rail. In December of 2004, the Hiawatha light rail line and expressway were completed. The 12-mile starter line carried 30,100 riders per day in the Fourth Quarter of 2007.[8] Federal New Start funds provided 46% of the cost. The line is in exclusive right-of-way at grade beside Hiawatha Avenue (which is part of the state highway network) until downtown where it runs in the street on dedicated right-of-way. The alignment connects Downtown Minneapolis to the Minneapolis-St. Paul Airport and the Mall of America in Bloomington. A major sports stadium and the University of Minnesota, Minneapolis campus, are also located within a half-mile of the corridor. Approximately 106,000 employees work within three blocks of the Hiawatha light rail line. Minneapolis' downtown housing market has far exceeded development projections. Ridership on the line is also far ahead of early estimates and the line's success has spurred community interest in building a regional transit system.

St. Louis, Missouri – Cross County Extension

The Cross County extension of St. Louis' Metrolink light rail system was completed in August of 2006. The eight-mile 'Shrewsbury' extension of the initial system was constructed using local funds and system ridership has spiked by 27,000 additional riders in its first year.[9] It is in exclusive right-of-way with one grade crossing and connects several destinations with minimal auto crossings. A decision was made to build the new Cross County line along the outskirts of Clayton, a major regional employment center, instead of into the heart of the employment district. The line connects to the larger light rail network that includes access to downtown and the Lambert International airport. The various municipalities served by the Cross County Extension have not developed specific measures to promote TOD but have seen $2 billion in development near stations. The City of Clayton is poised to adopt a TOD overlay district for its Forsyth Station and has approved a development project at that station that has the characteristics of TOD.

Los Angeles, California – Gold Line

The Gold Line in Los Angeles was completed in July of 2003. The 13.7-mile expansion to the Los Angeles light rail system was paid for using local funding. It runs in exclusive right-of-way and runs through a number of neighborhoods, gathering 22,231 riders per day in March of 2008.[10] The corridor was built on existing railroad right-of-way, making direct connections to employment and housing destinations challenging. Developers have been quick to acquire and develop available land adjacent to station areas. The line does, however, pass through many established residential neighborhoods, some of which require the train to slow down between Pasadena and Los Angeles. Given that there are few large commuter parking lots at the stations between Pasadena and Los Angeles, this line depends more on transfers from other modes and walk-up riders than park-and-riders.

Portland, Oregon – Interstate Max/Yellow Line

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[8] APTA NTD Ridership Accessed 8 May 2008.
<http://www.apta.com/research/stats/ridership/riderep/documents/07q4lr.pdf>

[9] Metrolink Press Release. 14 August 2007 (See Appendix)

[10] LACMTA Monthy Ridership Updates . Accessed 10 November 2007
<http://www.metro.net/news_info/ridership_avg.htm>

The 5.8-mile Interstate MAX light rail project was completed in April of 2004. After a regional bi-state ballot measure to fund light rail from Vancouver, Washington to Milwaukie, Oregon failed to pass, the Interstate MAX was identified as an extension that would serve close-in North Portland neighborhoods where light rail had strong support. The line runs in an exclusive right-of-way in the center of Interstate Avenue. Federal New Start funds paid for 73 percent of the project cost. The Interstate Max, now operating as the Yellow Line, carried 13,600 passengers per weekday in May of 2007.

Denver, Colorado – Southeast Corridor

The Southeast Corridor Light Rail line in Denver was a part of an ambitious regional plan to build a freeway and light rail line simultaneously, effectively doubling the reach of the light rail network in the Denver Region with 13 stations and 19 miles of new line. Completed in 2006, the line was built on time and under budget. It runs from the Lincoln Station southeast of Denver in Douglas County to Downtown and through the Denver Tech Center, and also serves two university complexes. The line was built for $46 million per mile.[11] The Federal New Starts program provided 60 percent of the funding for the project. The Southeast Corridor carried 36,000 people per day in October of 2007.[12] The Southeast Corridor is located along an interstate highway limiting the amount of land area available for future TOD development. The decision to locate the line adjacent to the highway avoided expensive land acquisition, helping to reduce project costs and construction time.

Sacramento, California – South Corridor LRT

The South Corridor light rail line in Sacramento, California is the minimum operating segment[13] of a larger planned South Corridor light rail line. Completed in 2003, the line runs 6.3 miles from Meadowview Road to Downtown Sacramento and was built on former Union Pacific rail right-of-way. The corridor includes various commercial, retail and housing developments and also connects to Sacramento City College. The Federal match for the project was 50 percent. In the third quarter of 2007, the South Corridor carried 9,252 weekday riders[14].

The Context for New Transit Investments

National Rail Gains

Public transit use has grown immensely over the last fifteen years and many more communities are considering new transit investments. In 2007, 10.2 billion trips were made on transit. From 1990 to 2005, after a dip in ridership during the period of cheap oil in the 1990's, national transit usage has increased almost 11.5%. Of that increase, rail transit accounts for 75%, or 763 million trips.[15] Passenger miles have increased also with rail modes accounting for 75% of the increase in national transit passenger miles since 1990.[16] From 1995, two years after the creation of the landmark Intermodal Surface Transportation Act

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[11] USDOT. Innovative Financing Primer. Case Study – GARVEEs. Denver T-Rex Project. April 2002. Accessed <http://www.fhwa.dot.gov/innovativefinance/ifp/ifprimer.pdf >

[12] RTD Denver Press Release. 16 November 2007. (See Appendix)

[13] The minimum operating segment (MOS) is an initial segment of a multi-segment line. Often due to cost or operations needs, a line is built in sections or segments. The South Corridor in Sacramento has built MOS1 and is currently doing preliminary engineering on MOS2.

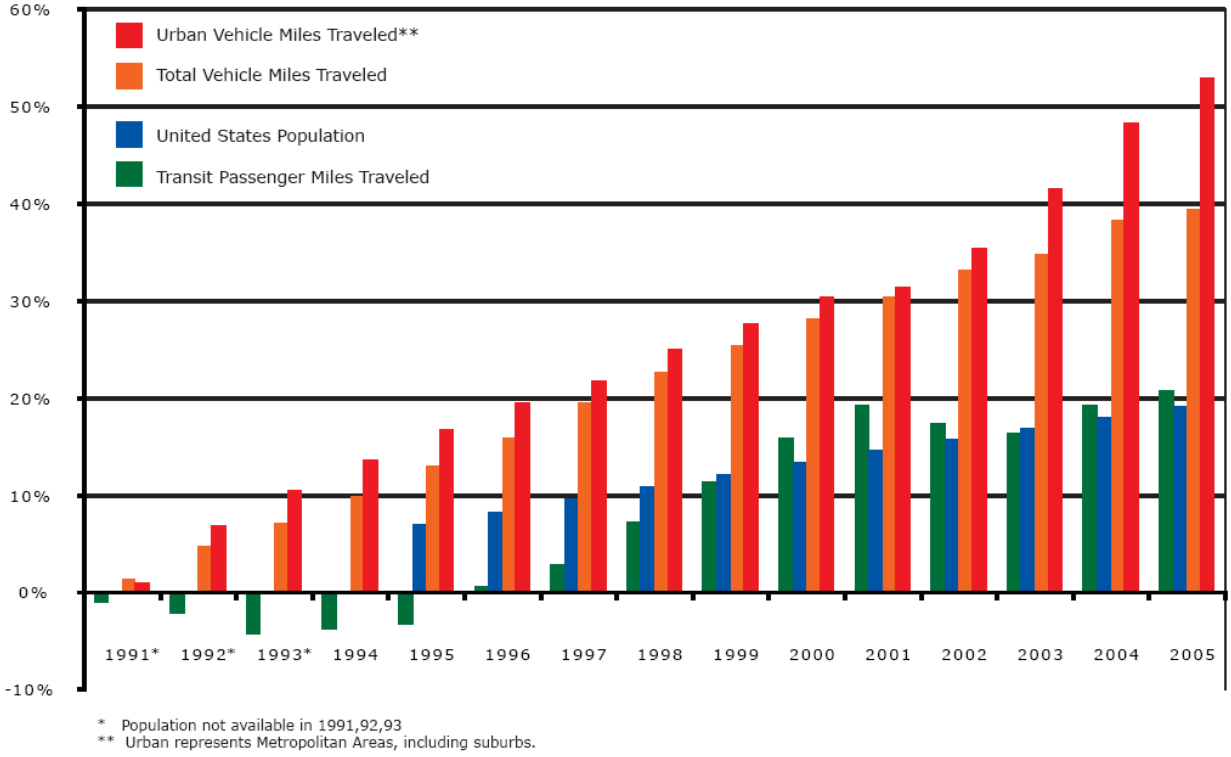
[14] Sacramento RT 3rd Quarter Blue Line Ridership Report

[15] APTA . 2007 Public Transportation Fact Book. 58th Edition May 2007. The Data is Also Available Online. Accessed 19 Novermber 2007. <http://www.apta.com/research/stats/ridership/trips.cfm>

[16] Bureau of Transportation Statistics (BTS). National Transportation Statistics: Transit Profile. Accessed 20 February 2008. <http://www.bts.gov/publications/national_transportation_statistics/html/table_transit_profile.html>

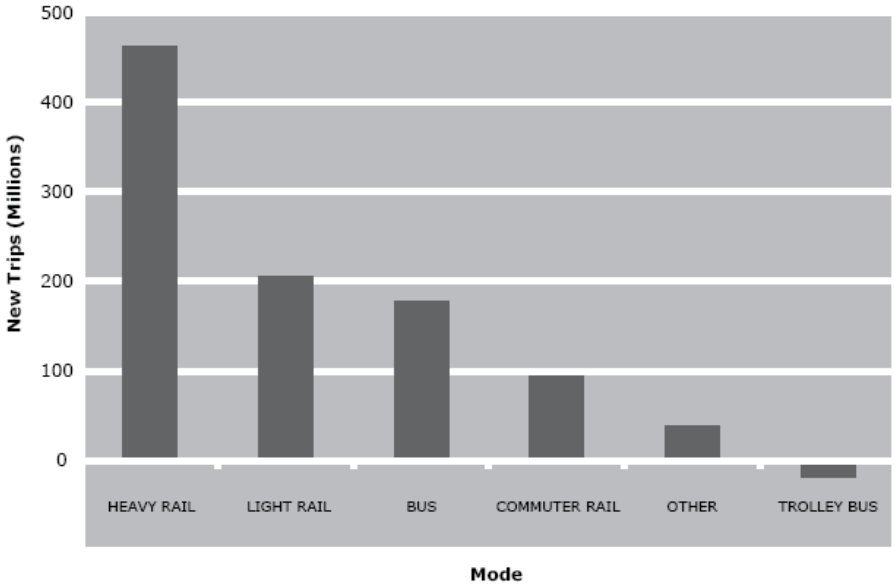
(ISTEA), to 2005 transit usage was more significant, increasing 26%. This represents a growth rate that is more than twice that of national population growth and is the most significant decade increase in transit usage since between 1974 and 1984 when transit trips increased 27% during the years of the oil crisis.

Figure 1. Transportation and Population Percent Change: 1990-2005



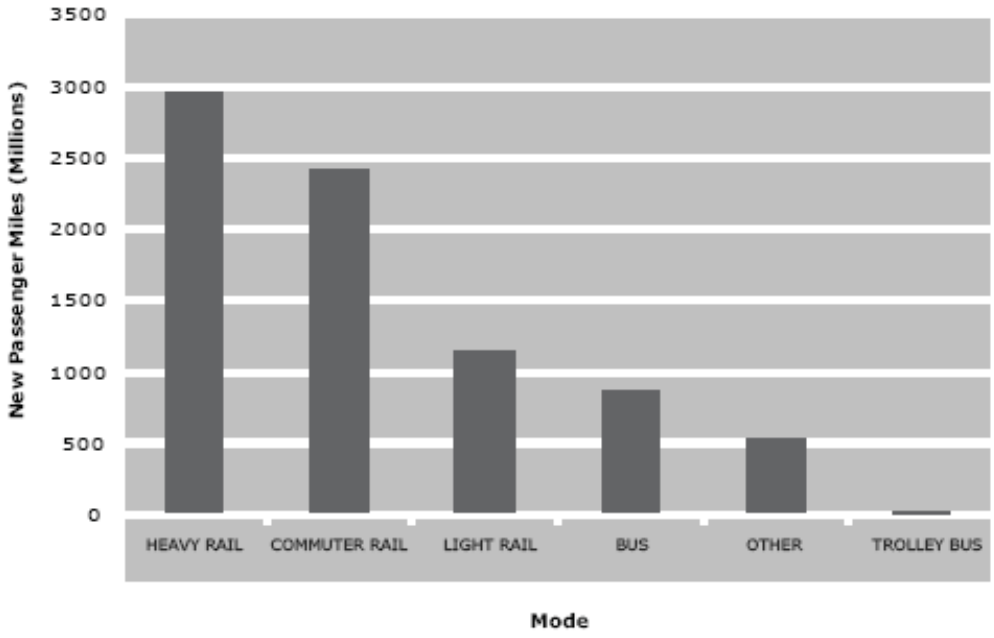
Source: Bureau of Labor Statistics, 2007

Figure 2. New Transit Trips 1990-2005



Source: APTA, 2007 statistics analyzed from the National Transit Database.

Figure 3. New Transit Passenger Miles 1990-2005

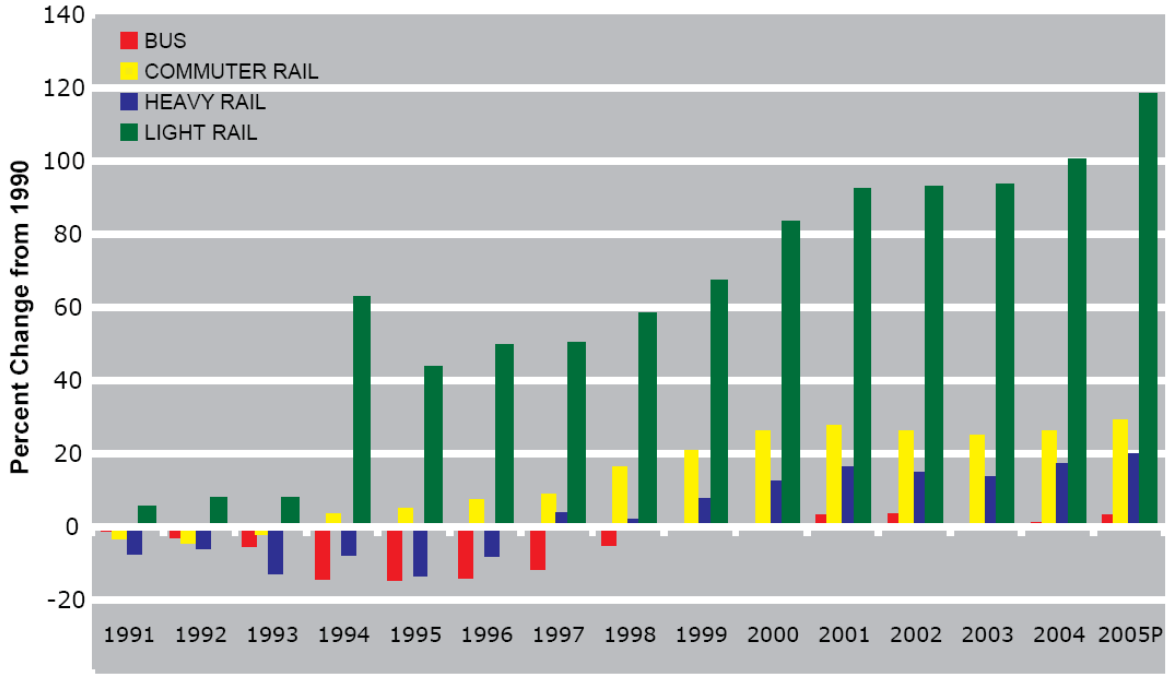


Source: Bureau of Transportation Statistics, 2007

The investment in new transit systems across the country has generated significant new transit riders. According to the American Public Transportation Association (APTA), trips on heavy rail have increased by 462 million between 1990 and 2005, or 19.7%. Light rail which comprises the regional rail systems in places like Denver, Portland and Sacramento, has seen the most dramatic increases in ridership from 1990 levels (117% in fifteen years), while commuter and heavy rail have seen slightly less increase over the same time frame (see Figure 3).[17]

[17] APTA. Historical Unlinked Passenger Trips by Mode. Accessed 25 September 2007. <http://www.apta.com/research/stats/ridership/trips.cfm>

Figure 4. Trips Percent Change from 1990 - 2005



Source: APTA, National Transit Database, 2007

Projected vs. Actual Transit Ridership

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 decision-making 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.

In 2007, FTA released a *Predicted and Actual Impacts of New Starts Projects: Capital Cost, Operating Cost and Ridership Data* to analyze 19 New Starts projects (both rail and bus guideways) that opened for revenue service after an earlier 1990 report.[18] The post-1990, pre 2003 projects showed improvements in the quality of forecasts. Three of the 19 projects generated ridership that was between 70 and 80 percent of their forecasts in the final environmental impact statement (FEIS). Another four projects generated ridership between 80 and 100 percent of their forecasts. And two projects had actual ridership that exceeded their forecasts by modest amounts. Eight of the projects however were operating at below 51% of estimated ridership. When projected to the forecast year, about half of the projects have a chance of

[18] Pickrell,D. *Urban rail transit projects: Forecast versus actual ridership and costs*. US Department of Transportation Washington, DC, 1990.

coming within 20% over or under their forecast margin. Table 2 below shows the results of this initial study. [19]

Table 2: Predicted vs. Actual Ridership – Forecast vs. 2002 Actual

Project	Forecast Year	Forecast Average Weekday Boardings		Actual Average Wkdy Boardings - 2002	Ratio	
		AA/DEIS	FEIS		Actual vs. AA/DEIS	Actual vs. FEIS
Atlanta North Line	2005	57,120	57,120	20,878	37%	37%
Baltimore Johns Hopkins	2005	13,600	13,600	10,128 *	74%	74%
Baltimore LRT Ext.	2005	11,804	12,230	8,272 *	70%	68%
BART Colma	2000	15,200	15,200	13,060	86%	86%
Chicago Orange Line	2000	118,760	118,760	54,986 *	46%	46%
Dallas South Oak Cliff	2005	34,170	34,170	26,884	79%	79%
Denver SW LRT	2015	22,000	22,000	19,083	87%	87%
Houston SW Transitway	2005	27,280	27,280	8,875	33%	33%
Jacksonville ASE	1995	42,472	42,472	2,627	6%	6%
LA Red Line	2000	295,721	297,733	134,555	46%	45%
Miami Omni/Brickell	2000	20,404	20,404	4,158	20%	20%
Pittsburgh West B'Way	2005	23,369	23,369	9,000	39%	39%
Portland Westside-Hillsboro	2005	60,314	49,448	43,876	73%	89%
Salt Lake South LRT	2010	26,500	23,000	22,100	83%	96%
San Diego El Cajon	2000	21,600	21,600	24,950	116%	116%
San Jose Guadalupe	1990	41,200	41,200	21,035	51%	51%
San Jose Tasman West	2005	14,875	13,845	8,244	55%	60%
St. Louis Initial System	1995	41,800	37,100	42,381 *	101%	114%
St. Louis St. Clair Ext.	2010	11,960	20,274	15,976	134%	79%

* Figures are for 2001 (2002 not available at time of preparation)

Source: Contractor Performance Assessment Report Federal Transit Administration[20]

In order to evaluate the reliability of local travel models and funding assumptions, it is instructive to compare the projected ridership against actual recent ridership counts. For some lines, especially system extensions, it may be equally important to evaluate ridership on the entire transit system. For those lines that were funded through the Federal New Starts program, local ridership models were subjected to rigorous review by the Federal Transit Administration (FTA) as part of the ranking process. Yet despite the increasing efforts to improve local ridership forecasting models, research funded by the FTA has found that ridership projections may still be inaccurate due to unknown swings in the economy and unforeseen or limited growth.[21]

FTA has developed a stand-alone computer modeling program, SUMMIT, to provide a common analytical framework for evaluating all New Starts projects. SUMMIT uses locally prepared ridership

[19] Federal Transit Administration, Office of Planning and Environment. *Contractor Performance Assessment*, September 2007. US Department of Transportation <http://www.fta.dot.gov/documents/CPAR_Final_Report_-_2007.pdf>

[20] Ibid.

[21] Federal Transit Administration. *Discussion Piece 6:Predicted vs. Actual Ridership of Proposed New Starts Projects*. 6 June 2006. <www.fta.dot.gov/documents/Discussion_6_Predicted_and_Actual.doc>

forecasts for the "baseline"[22] and "build"[23] alternatives to compute transit system user benefits (TSUB)[24] for proposed New Starts projects. Second, it provides a variety of analytical reports on the computed user benefits and the locally prepared ridership forecasts. The TSUB calculation is used to quantify the mobility and cost-effectiveness measures in FTA's New Starts evaluation process. In its most recent published Policy Guidance for New Starts projects, taking effect in Fiscal Year 2009, FTA proposes that travel forecasts for both New and Small Starts projects seeking to enter preliminary engineering (PE) or project design (PD) be based on travel models that have been validated against data on current ridership patterns collected no more than five years prior to the PE or PD request.[25] This represents a continued effort by FTA to obtain more reliable transit ridership projections.

The question arises however; is the current computer model (SUMMIT) effective at estimating ridership and user benefits? Much of the problem with using traditional travel models for analyzing an individual transit corridor is that they are based on transportation and land use inputs at the aggregate, regional scale. These models are generally unresponsive to changes at the station-level both in terms of transit-supportive land use and development, and improved transit service or access. Furthermore, the wide variance between projected and actual ridership levels in more than a few cases indicates that additional variables might be needed to reflect the behavior of people when transit either links key regional destinations or provides a greater degree of transit connectivity.

Table 3 shows projected ridership reported in past FTA New Starts Reports and transit agency projections versus the current actual ridership reported by individual transit agencies for newly opened transit lines. Current actual ridership was garnered from a number of sources including the National Transit Database (NTD) and from data collected directly from the sponsoring agency.[26] Of the lines above, seven have exceeded projections, eight seem on target to beat their projections, and two did not meet their projections for the opening year. Three lines did not have data available.

Table 3. Projected vs. Actual Ridership, 2003-2006

[22] The New Starts Baseline Alternative should represent the "best that can be done" to improve transit service in the corridor without major capital investment in new infrastructure.

[23] The build alternative is the project seeking funding as opposed to the baseline alternative and "no build" alternative which means nothing would be done on the corridor above existing service.

[24] Transit system user benefit (TSUB) takes the local travel model and calculates the travel time savings for riders taking the new transit mode versus other modes and alternatives.

[25] Federal Transit Administration, Office of Planning and Environment. *Proposed Guidance on New Starts/Small Starts Policies and Procedures*, February 5, 2007. US Department of Transportation.

[26] A variety of sources were used to collect information on actual ridership because there is no single source for ridership on individual transit lines. It would likely be good policy to require agencies to report line ridership or station ridership in addition to system ridership in order to compare projected versus actual.

City	Line	Segment Opened	Projected Ridership	Projected Date	Actual Ridership	Reporting Date	Source	New Starts
Los Angeles	Gold Line Phase I	2003	26,000	2004	22,231	3.08	LACMTA	N
Sacramento	South Corridor LRT Phase I	2003	12,550	2015	9,252	Q3.07	Sac RT	Y
Salt Lake City	Medical Center Extension	2003	4,100	2020	Unavailable			Y
Tacoma	Tacoma Link	2003	2,000	2010	3,171	Q4.07	Sound T	N
St. Louis	St. Clair Extension	2003	13,502	2010	14,382	4.08	Metro	Y
Tampa	TECO Line	2003	950	2003	1,082	Q1.06	TECO	Y
Houston	Main Street Metrorail	2004	39,000	2020	41,700	Q4.07	NTD	N
Memphis	Medical Center Expansion^^	2004	4,100	2020	607	FY07	MATA	Y
Minneapolis	Hiawatha Line	2004	24,800	2020	30,100	Q4.07	NTD	Y
New Jersey	Camden-Trenton River Line	2004	5,900	2004	7,900	Q3.07	NJT	N
Portland	Yellow Line/Interstate	2004	18,100	2020	13,600	5.07	Tri-Met	Y
San Jose	Tasman East Extension	2004	Line Data Unavailable					N
Little Rock	River Rail***	2004	130,000	2004	133,321	2007	CAT	Y
San Diego	Green Line^	2005	10,800	2015	7,047	6.07	SanDag	Y
San Jose	Vasona Extension	2005	8,000	2005	Unavailable			N
Denver	Southeast Corridor	2006	38,100	2020	36,000	10.07	RTD	Y
New Jersey	Newark Rail Link MOS1	2006	24,900	2015	19,050	Q3.07	NJT	Y
New Jersey	Hudson Bergen Line MOS2*	2006	61,900	2010	38,200	Q3.07	NJT	Y
Sacramento	Folsom to Amtrak Extension	2006	3,154	2015	6,455	Q1.07	Sac RT	N
St. Louis	Cross County^	2006	18,960	2020	12,760	4.08	Metro	N
Portland	Streetcar Expansion**	2007	3,500	2001	6,320	Q4.05	PSI	N

Notes[27]:

* The projected ridership is the sum of MOS1 and MOS2. The system ridership of the two segments is quoted

** Ridership and projections are for the first segment. The line was expanded twice after Q4 in 2005.

*** Central Arkansas Transit reports annual figures and projections for the streetcar

^ These lines ridership were projected for the new stations. The routes serve more.

^^ Just after construction of the Medical Center Expansion the medical center unexpectedly closed and the building was imploded. A new biotech center is under construction.

Source: CTOD, 2008.

Ridership projections for all lines are estimated for boardings at the stations within the newly constructed segment and do not include potential ridership gains occurring throughout the larger regional transit system. For example a trip taken from a newly constructed station to an existing downtown station will be counted however the trip on the way back from the downtown station will be counted as a boarding at the downtown station and not on the new segment. The impact of the new segment can however be represented as the impact of the new extension on overall system ridership. In St. Louis, the Cross County line has caused the *system* projection to surpass its 2025 number decades ahead of schedule. Ridership on the region's two light rail lines was expected to reach 86,000 in 2025, yet 88,000 average weekday boardings occurred in August of 2007, an increase of 27,000 riders from the previous year in that month

[27] Ridership fluctuates between quarters. Historically, Q3 seems to have the highest ridership of the year.

alone.[28] Officials at the transit agency state that the "Shrewsbury effect" could be quantified as adding 20,000-22,000 riders a day throughout the system even though ridership at the stations is only 12,760. [29]

In Denver, system gains were 17% above predictions for the first year with many of the riders being new to transit.[30] This means that the true impacts of ridership are not seen as just ridership additions at those stations along the new line but also in potential system wide ridership gains. As more destinations open up to more riders, an easy connection between rail lines is seen as more attractive than previously thought or as estimated by the predictive models.

Discrepancies in before and after ridership may also be the result of service changes that happened after opening date and which were not reflected in initial ridership projections. The Green Line in San Diego for example now terminates at Old Town Transit Center instead of Downtown. [31] This points to the fact that things can change after opening a new transit line that transit agencies might or might not have control over, making predictive models good at predictions, but perhaps not always accurate.

Federal Evaluation of Proposed Transit Investments

The Federal New Starts program seeks to establish a method for evaluating the costs and benefits of proposed projects seeking federal funding. Six of the eight projects discussed in this paper received Federal ratings as part of the New Starts process. The Gold Line in Los Angeles and St. Louis' Shrewsbury Extension were not rated but has been included to look at corridors that exclusively used local funding. The South Corridor line in Sacramento was in the New Starts program prior to evaluation changes made in 2003 with the introduction of the SUMMIT model to evaluate cost effectiveness.

Federal Project Justification Ratings

The Federal New Starts process includes an evaluation and ratings framework. Federal transportation law requires FTA to determine that projects proposed for New Starts funds meet a variety of criteria, including that they are the result of an alternatives analysis; are included in an approved transportation plan; that the applicant has the legal, financial, and technical capability to carry out the project; that the project is justified based on a review of the criteria specified in law; and that the project is likely to continue to meet those requirements in the future, before projects are allowed to begin preliminary engineering or final design. FTA's current approach to advancing projects through planning and project development is found at http://www.fta.dot.gov/index_5221.html and summarized in Figure 5.

Between 2003 and 2007, FTA has used a three-tier rating framework (recommended, highly recommended and not recommended) for reporting on projects in the Federal New Starts pipeline. The

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[28] Metrolink Press Release. 14 August 2007 <http://www.metrostlouis.org/InsideMetro/NewsRoom/releases/2007-031MLJulyRidership.pdf>

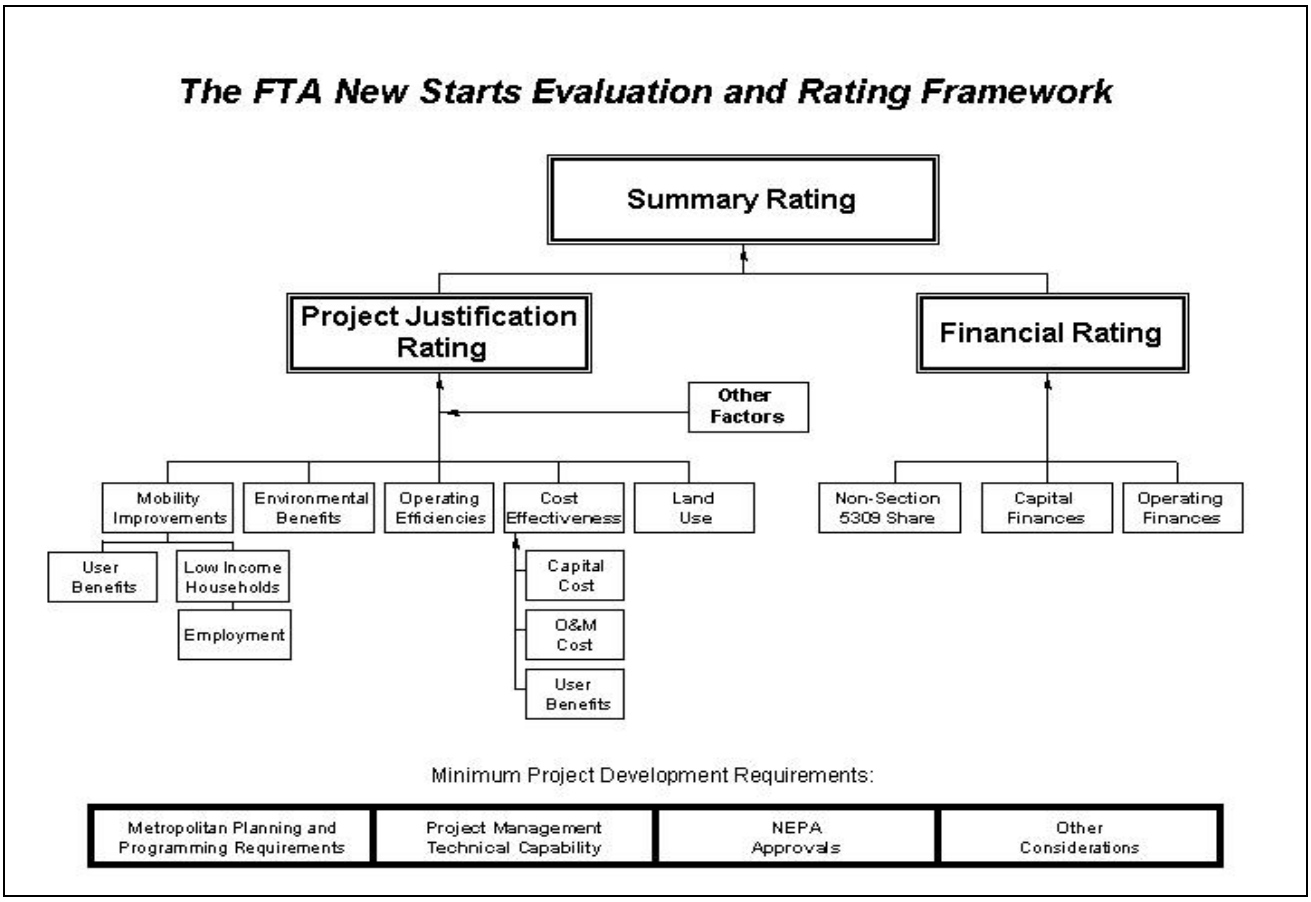
[29] Email Correspondence with Metro St. Louis Metro. 1 May 2008.

[30] RTD Press Release, 17 November 2007 < http://www2.rtd-denver.com/RTDNews/NewsRelease/November/Southeast%20Light%20Rail%20Line%201st%20Anniversary%20NR%202007.pdf>

[31] In its analysis for the Federal New Starts process, San Diego's proposed Green Line, also referred to as Mission Valley East, was modeled for anticipated service to downtown and had a ridership projection of 10,800 in 2015. In May of 2007, only 7,047 boardings were reported on the Mission Valley East segment. The operating segment, however, stops at the Old Town Transit Center where riders must transfer to an Orange Line train to reach downtown. It's possible that the change in service from service planned in the New Starts report is one of the reasons why the line has not yet met its ridership projections. The Green line from Santee Town Center to Old Town Transit Center registered almost 27,000 boardings in September of 2007.

overall rating is based on the project justification and financial ratings. In addition to an overall project rating, project proposals are also evaluated and rated on several project justification criteria, including land use and cost effectiveness that contribute to the project justification rating, and also a local financial commitment rating. The FTA used low, medium low, medium, medium high, and high for their project justification criteria ratings system. On March 9, 2005 the FTA Administrator issued a "Dear Colleague" letter that proposed altering the New Starts rating process so that only those projects receiving a "medium" or "high" cost effectiveness rating would be recommended for funding, regardless of the project's overall rating.

Figure 5. Current Federal New Starts Evaluation and Rating Framework



Source: Federal Transit Administration

FTA has made modifications to the existing Federal New Starts evaluation and ratings frameworks to reflect changes in law established under SAFETEA-LU in 2005 including the creation of a new Small Starts program, and to formalize the 2005 Dear Colleague letter.

The existing Project Justification evaluation framework considers the following factors: mobility, land use, cost-effectiveness, environmental benefits and operating efficiencies. Land Use and Cost Effectiveness comprise the major of the rating for this measure. These are each summarized briefly below.

Mobility Improvements: The mobility measure in the New Starts program takes the user benefits (travel time savings in minutes) per passenger and combines it with benefits for transit dependent riders

including calculating the share of transit dependents in the region versus the share of benefits received in the project.

Land Use: The land use measure is a measure of three factors; the existing land use, transit supportive plans and policies and performance and impact of these policies. Each of these measures is reassessed throughout the process as a qualitative measure.

Cost Effectiveness: The Cost Effectiveness Index takes two measures. First the cost is calculated by taking the annualized costs of the project and dividing it by the costs of a baseline project. Those costs are then divided by system user benefits, of which travel time savings is a key factor.

Environment: The Environment measure takes the EPA ratings for air quality non-attainment. Regions building transit lines in non-attainment areas automatically receive a high rating. As noted by the FTA, regions report environmental benefits in the New Starts report but it is not taken into account when rating a project.

Operating Efficiencies: Operating efficiencies will no longer be considered as a stand alone criteria as it is claimed that their benefits are captured within the cost effectiveness rating. In previous years however, operating efficiencies related to the system operating cost per passenger mile. [32]

New Starts Ratings of Case Study Corridors

The land use ratings reported in Table 4 below demonstrate some of the inherent challenges of FTA's approach to this criterion. Congressional and industry concern has been raised regarding the application and transparency of FTA's evaluation criteria for this measure given that many projects seem to receive a medium rating, despite very different land use patterns and policies. To illustrate this, contrast the ratings for Houston and Denver. According to the 1999 New Starts report, Denver's "*Medium* land use rating reflects both the existing and relatively dense land uses and strong transit supportive policies within Denver *and* the generally less dense development and weaker policies outside of the City."[33] Compare this to San Diego which received a Medium High rating. "The *Medium-High* Land Use rating reflects the City's and MTDB's successful efforts to foster transit-oriented development both along the Mission Valley East corridor and throughout the light rail system."[34] Both regions appear to have taken similar strategies, but receive different weights. Contrast these two examples with Houston, who ultimately bypassed Federal funding but received a medium land use rating while the project was in the New Starts program. "The *Medium* land use rating reflects strong existing conditions and trip generators in the corridor with a pro-active public and private sector effort to implement plans and policies."[35] Yet Houston has not adopted TOD supportive zoning and parking policies.[36] This would limit Houston's

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[32] Federal Transit Administration Office of Planning and Environment. *FY 2009 New Starts and Small Starts Evaluation Process*. 20 July 2007. <http://www.fta.dot.gov/documents/FY_2009_Eval_Process.doc>

[33] Federal Transit Administration. Annual Report on New Starts: 2001 Denver Colorado, Southeast Corridor LRT. Accessed 10 October 2007.<http://www.fta.dot.gov/printer_friendly/planning_environment_2925.html>

[34] Federal Transit Administration. Annual Report on New Starts: 1998 San Diego California, Mission Valley East LRT. Accessed 10 October 2007 <http://ntl.bts.gov/lib/7000/7600/7625/chapters/SD-Mission_Valley_East.html>

[35] Federal Transit Administration. Annual Report on New Starts: 2002 Appendix A. Downtown to Astrodome Light Rail. Houston, Texas. Accessed 10 October 2007. <http://www.fta.dot.gov/printer_friendly/planning_environment_3165.html>

[36] Environmental Protection Agency. Building Houston's Competitive Edge: Transit-Oriented Development for the Ensemble/HCC Station. 27 October 2006. Available Online <http://www.epa.gov/smartgrowth/pdf/houston.pdf>

ability to promote denser development. Yet it is rated "Medium" the same as Denver, where substantial TOD policies are in place.

Table 4. New Starts Project Ratings for Study Corridors

New Starts Project	New Starts Info Year	Mobility	Land Use	Cost Effectiveness	Justification	Overall Rating
Denver	2001	Medium	Medium	Low -Medium	Medium	Recommended
St. Louis	NA	NA	NA	NA	NA	NA
San Diego	2001	Medium	Medium-High	Medium-High	Medium High	Highly-Recommended
Portland	2001	High	High	Medium-High	High	Highly-Recommended
Houston	2000	Medium	Medium	Medium-High	Medium	Recommended
Minneapolis	2001	Low-Medium	Medium-High	Low -Medium	Medium	Recommended
Los Angeles	NA	NA	NA	NA	NA	NA
Sacramento	1998	Medium	NR	NR	NR	Recommended

* NA Means that the line was never in the New Starts Process

Source: Federal Transit Administration, Annual New Starts Report, select years

What separates Denver and Houston from San Diego or even Portland is the number of major trip generators and the strong transit supportive policies both in the corridors and throughout the regions.[37] This is consistent with literature regarding the "five D's" that has been found to impact trip generation: density, destinations, diversity of uses, design and distance to travel. The importance of these multiple factors towards influencing ridership, and ultimately a line's success has underscored the use of a multi-measure approach to evaluating potential new transit lines.

Since 2005, in order for a project to enter and move forward through the Federal New Starts process, its cost effectiveness rating must at least be a "Medium", regardless of the ratings for other project justification criteria. Had this threshold been in effect earlier, some of the projects listed in Table 1 would not have been recommended, including the Denver, Minneapolis and Charlotte lines. Each of these lines is exceeding initial ridership expectations which would have had the effect of lowering their cost effectiveness rating. In order to receive funding, these cities were able to improve their overall rating with a boost from their Land Use and Mobility ratings to help elevate their project justification and overall rating. Other lines that received below a Medium cost-effectiveness rating include projects under construction such as the Gold Line East Corridor in Los Angeles, the Euclid Corridor BRT in Cleveland, and the Phoenix starter line.[38]

Table 5 shows a list of projects that were funded despite having a Medium-Low or Low cost-effectiveness rating. Many of these projects were funded when other measures such as Land Use and Mobility elevated the overall project score. Many projects also were pushed through as a part of the political appropriations process once it was seen that they would not pass the FTA's evaluation method. Two of the projects below were exempted in the political process from the March 2006 cost effectiveness policy including the Wilsonville Commuter Rail and the Salt Lake City Commuter Rail. Five projects were exempted by statute, including heavy rail lines, such as BART-to-San Jose and Metro-to-Dulles Airport.

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[37] Federal Transit Administration. Annual Report on New Starts: 2001 Interstate Max LRT Extension. Portland, Oregon. Accessed 10 October 2007. <http://www.fta.dot.gov/publications/reports/planning_environment_2941.html>

[38] Federal Transit Administration. Annual Report on New Starts: 1997 to 2008. Accessed 10 October 2007. <http://www.fta.dot.gov/planning/newstarts/planning_environment_2618.html>

Table 5. Projects that Received Federal Funding Despite Below-Medium Cost Effectiveness Ratings

FY New Starts Report	Location	State	Project	Cost Effectiveness Rating	President's Budget Recommendation	Mode	FFGA Awarded
1996	Hudson-Bergen	NJ	Hudson-Bergen MOS-1	--	FFGA & Funding	Light Rail	Yes
2000	Dallas	TX	North Central	Medium-Low	FFGA & Funding	Light Rail	Yes
2000	Salt Lake City	UT	Downtown Corridor	Medium-Low	FFGA & Funding	Light Rail	--
2000	Los Angeles	CA	Orange Line BRT	Medium-Low	N/A Local	Bus Rapid Transit	No
2000	San Francisco	CA	Third Street Light Rail I	Low	N/A Local	Light Rail	No
2001	Denver	CO	Southeast Corridor	Medium-Low	FFGA & Funding	Light Rail	Yes
2001	Minneapolis	MN	Hiawatha	Medium-Low	FFGA & Funding	Light Rail	Yes
2001	Hudson-Bergen	NJ	Hudson-Bergen MOS-2	Low	FFGA & Funding	Light Rail	Yes
2002	Chicago	IL	Metra UP West	Medium-Low	FFGA & Funding	Commuter Rail	Yes
2003	Los Angeles	CA	Eastside	Low	FFGA & Funding	Light Rail	Yes
2005	Phoenix	AZ	Central / East Valey	Medium-Low	FFGA & Funding	Light Rail	Yes
2005	Raleigh	NC	Regional Rail System	Medium-Low	Funding	Commuter Rail	No
2005	Cleveland	OH	Euclid Corridor	Medium-Low	FFGA & Funding	Bus Rapid Transit	Yes
2005	Pittsburgh	PA	North Shore	Medium-Low	FFGA & Funding	Light Rail	Yes
2006	San Diego	CA	Mid Coast	Medium-Low	Funding	Light Rail	No
2006	Charlotte	NC	South Corridor	Medium-Low	FFGA & Funding	Light Rail	Yes
2006	Portland	OR	Wilsonville-Beaverton		Funding	Commuter Rail	Yes
2006	Salt Lake City	UT	Weber Co to SLC	Medium-Low	Funding	Commuter Rail	Yes
2007	N. Virginia	VA	Dulles Corridor Metrorail	Medium-Low	Funding	Heavy Rail	No
2008	Minneapolis	MN	Northstar	Medium-Low	Funding	Commuter Rail	Yes

- TEA-21 Rating Process initiated in FY 2000 New Starts Report (published in Feb 1999)
- Cost-effectiveness calculation method: Incremental Passenger (FY00 - FY03) / Transportation System User Benefit (FY04 - FY06)

Source: CTOD, 2007

Challenges with Ridership Estimation

The complex movements of people have made it inherently hard to estimate the true benefits of transportation systems and transit ridership accurately. Many models have not been able to account for certain types of trips that occur once a transit line is built. For example, a line that serves a number of destinations should have increased and sustained long-term ridership due to its utility. People may not ride the line every day to commute to work, but will use the line to attend a sporting event or visit their doctor. Or, if they do commute via transit, they might also use transit for evening activities if that same line is easily and conveniently connected to cultural venues. Overall, the effect of linking destinations is to both boost transit ridership and provide an additional set of "occasional" riders to the system. Similarly, lines that run through underutilized and vacant properties may also see ridership gains as these areas redevelop, particularly if transit-supportive land uses and development policies are implemented, and in fact, the transit investment itself may be a factor in stimulating development interest at these sites. Both types of transit investment may be warranted. A question then is how to successfully plan for and model these different types of transit lines.

One of the most frequent errors in estimating ridership involves the magnitude and location of future population and employment growth. Transit relies heavily on walking for access/egress, and as a consequence, 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.[39] In addition, recent research shows that ridership models are possibly overestimating suburban station area ridership and underestimating urban ridership due to mode constants that measure the utility of a trip by automobile in the suburbs versus a transit trip the same way as in urban environments. This would mean that there is no spatial correlation of suburban to city core transit versus an urban corridor.[40]

Currently, many transit authorities are looking into ways to measure the effect of land use decisions on transit ridership. Most of the current models only take into account growth assumptions made at a macro level by the Metropolitan Planning Organization (MPO) and according to regional socio-demographic data. Typically, ridership models for specific projects are prepared by the regional transit agency and focus on more micro level information. Due to the scale of data, the ridership effects of focusing development around the transit system is often not modeled very accurately. San Diego uses land use forecasts to estimate what will be on the ground in the vicinity of the transit stations for the forecasted year and that may help provide a greater level of accuracy to their ridership estimates.[41] Portland has developed sophisticated land use measures that are built into its models which determine accessibility and ridership; however, they are very recent and were not used when the Interstate MAX line was planned.[42]

In modeling future ridership on Denver's Southeast Corridor, the local travel models assumed limited land use changes. According to one official at RTD, "The MIS and EIS projected growth around station areas, but certainly not at transit-supportive densities like what we are seeing getting built and proposed today."[43] At the time of corridor planning, after the "dot com" bust of the late 1990s, the Denver real estate market was in a down period. However, since construction and service initiation the corridor has seen large amounts of investment along the line. It's possible that this specific example is a result of our general misunderstanding of transit's ability to focus growth. Recent research prepared for the Gold Line extension in Pasadena shows that the rail line will generate new markets based on connections created between vacant available land and Universities and job centers.[44] However this type of change is virtually impossible to be accurately predicted solely by a model, given that demand is driven by changing market forces based on human choices and not mathematical equations.

Some trip types might not be well measured in existing models. For instance, it is possible that student ridership may be undercounted due to irregular travel patterns or extra incentives to not drive. Universities and transit agencies could boost the number of riders by offering student transit passes as a further incentive for students to use the transit system. In San Diego, St. Louis and Denver, where major universities are connected to light rail lines, student trips may have been underestimated in ridership projections. In San Diego, officials at the regional metropolitan planning organization stated that more students were using the line than anyone anticipated.[45] The Cross County line sees transfers to the initial

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[39] Federal Transit Administration, "Discussion-piece on Predicted and Actual Ridership of Proposed New Starts Projects." June 6, 2006.

[40] Goetzke, Frank. Network Effects in Public Transit Use: Evidence from a Spatially Autoregressive Mode Choice Model for New York. *Urban Studies*, February 2008.

[41] Tom King, Associate Research Analyst. SANDAG. Email Correspondence. 31 May 2007

[42] Jennifer John Manager Tri-Met. Email Correspondence 14 September 2007.

[43] Denver RTD Staff. Email Correspondence. 5 July 2007. (See Appendix)

[44] Strategic Economics. Metro Gold Line Foothill Extension: Market Conditions and Opportunities for TOD. January 2008.

[45] Tom King. Associate Research Analyst SANDAG. Email Correspondence 25 May 2007

MetroLink segment for people going to the University of Missouri-St.Louis or Washington University.[46] Denver's Southeast Corridor has seen student ridership dominate off-peak trips. Planners at RTD believe their travel models underestimated the amount that students would ride in the off-peak periods.[47] Sacramento Regional Transit has an agreement to provide heavily discounted passes to students enrolled at Los Rios Community College District schools of which Sacramento City College is associated. Many downtown businesses are members of the Sacramento Transportation Management Association (TMA) which promotes alternative transportation options and provides a guaranteed ride home service. In addition, many downtown buildings are occupied by governmental agencies that offer discounted transit passes.

Special event trips at stadiums, such as entertainment draws like sporting events, headline concerts, or other similar regional events, are another phenomenon undercounted in trip models, but generating significant ridership. A growing list of examples illustrate this trend:

- For every Padres baseball game in July of 2007, the San Diego Trolley carried 8,600 riders per game.[48]
- The San Diego Chargers garnered 63,000 riders for two football games in September.[49]
- During the 2007 Houston Livestock Show and Rodeo, the Main Street Line was taking 63,000 riders per day.[50]

Among the eight selected corridors, several have special events trip generators. St. Louis benefits from having three sports stadiums located on its main line, including professional hockey, baseball, and football. The Hiawatha line in Minneapolis has two sports stadiums and connections to numerous other major entertainment venues. Their local travel model failed to account for episodic, although considerable, sporting events ridership[51] The Hiawatha line also includes two airport terminals. Recently one of the station platforms was closed and total ridership has dropped 6 percent due to the closure. Also not modeled are people who fly into the Minneapolis-St Paul international airport and take the Hiawatha line to the Mall of America, a strategy promoted nationally by the Mall.[52] Denver connects to its professional football, baseball, basketball, hockey and lacrosse stadiums with its transit system, thus generating a great deal of special events riders. Houston has the most special events venues along its line. Three sports stadiums and robust museum and zoo districts are connected to each other on the Main street line. Current average weekday ridership according to local officials is around 48,000 while the modeling projected 18,000-20,000 riders.[53] Sports stadiums might be good for ridership and maybe used by project applicants to inflate ridership numbers artificially in some cases, but they might not be good for TOD. Typically the design of these large venues includes large areas for parking and hostile pedestrian environments. More understanding is needed of this phenomenon to judge whether these uses are truly beneficial or hurtful to transit, but there are ridership implications and model issues that should be studied further.

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[46] Tom Shrout. Citizens for Modern Transit Advocacy Group Correspondence 25 May 2007

[47] Denver RTD Staff. Email Correspondence. 5 July 2007.

[48] San Diego Trolley Ridership Report. July 2007

[49] San Diego Trolley Ridership Report. September 2007

[50] Todd Mason. Houston Metro. Vice President of Real Estate Services. Phone Interview 17 September 2007

[51] Interview with Connie Kozlak, Transportation Planning Manager at Met Council. 12 September 2007

[52] Ibid

[53] Todd Mason. Houston Metro. Vice President of Real Estate Services. Phone Interview 17 September 2007

The Effects of Connecting Destinations

There are two issues that need greater discussion and understanding relating to the importance of connecting funding for transit to its intended purpose of serving more riders:

1. The importance of connecting regional destinations with new transit alignments, and
2. The consideration of the role of networks and network effects to gain market share

Destinations Matter when Choosing Alignments

The function of the transit line has a clear and observable impact on ridership. For example, a commuter rail line that stops every two miles, connects suburban communities to downtown jobs, and depends on patrons driving to the station is likely to function differently than a subway line located in a busy urban area with stops every few blocks, and surrounded by intensive development and a pedestrian-oriented environment. These differences need to be acknowledged and measured when deciding which transit line should receive funding or which mode best fits local conditions.

In order to more accurately estimate the ridership differences between a bus-only system and a bus and rail system, the FTA has developed "modal constants" for the TSUB evaluation process. Currently, regions that are building new transit lines are not able to put in a modal constant or "bias" into the model.[54] This stems from the fact that each region has a different reaction to improved transit. After an initial line is completed, a bias can be derived based on actual performance to inform the modeling of future expansions. For example, Minneapolis is now allowed to use a rail bias for the Central Corridor now that it has a working example of how the Hiawatha Line outperforms local transportation models. However, the lack of a "modal constant" for all projects is a disadvantage for project sponsors that are seeking to introduce a new mode and could result in a low cost effective rating for a "new start", essentially killing a worthy project. Also, the role of networks seems to play a key role in growing transit ridership. Recently, Houston was able to upgrade their New Starts projects to light rail from BRT because network modeling showed greater ridership numbers than modeling the individual lines alone.[55]

But relying extensively on ridership and cost alone illustrates only part of the benefits of transit investments. A local decision to build a transit line is as much, if not more, about connecting people to jobs, education and cultural opportunities and stimulating economic development, as it is about the expected cost of the capital expenditure. Thus, an inherent tension arises between the interests of local and federal proponents of transit investments. Furthermore, research has shown that not only do residential developments around the station areas matter in terms of generating transit ridership, but the presence of business districts affect the use of transit much more than waiting for residential uses to sprout up along the line.[56] So it would seem that connecting destinations is a sound strategy for generating ridership gains.

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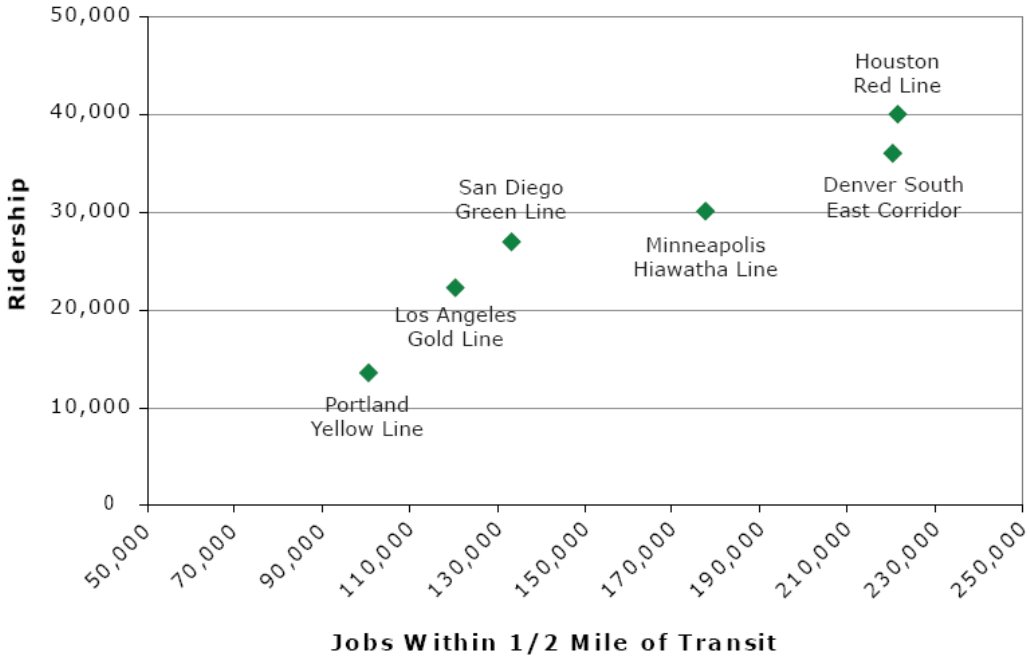
[54] Federal Transit Administration, Office of Environment and Planning, *Proposed Policy Guidance on Evaluation Measures for New / Small Starts.* US Department of Transportation, August 3, 2007.

[55] Editorial Staff. *Connecting the Tracks*. Houston Chronicle. 20 October 2007. Accessed 30 October 2007. <http://www.chron.com/disp/story.mpl/editorial/5230480.html>

[56] Barnes, Gary. The Importance of Trip Destination in Determining Transit Share. Journal of Public Transportation, Vol 8, No.2, 2005.

Table 6. Jobs and Ridership on Recently Constructed Light Rail Lines [57]

Light Rail System	1/2 Mile Jobs	Recent Ridership
Houston Red Line	221,431	40,000
Denver SE Corridor	220,254	36,000
Minneapolis Hiawatha	177,453	30,100
San Diego Green	133,157	26,923
Los Angeles Gold	120,441	22,231
Portland Yellow	100,434	13,600



Source: 2004 LEHD Data, NTD Q4 2007, transit agency data, CTOD

Connecting destinations with transit can be difficult and getting connectivity from door-to-door is even more challenging. Officials in St. Louis County made a conscious decision to build the new Cross County line along the outskirts of Clayton, a major regional employment center instead of into the heart of the employment district. [58] Given that most of the Metro system is built with limited grade crossings and in a former railroad right-of-way, the result might have been a subway section through the center of the business district or a street-running section of the line. Instead, the Cross County line skirts the side of a major employment center in favor of avoided construction costs.

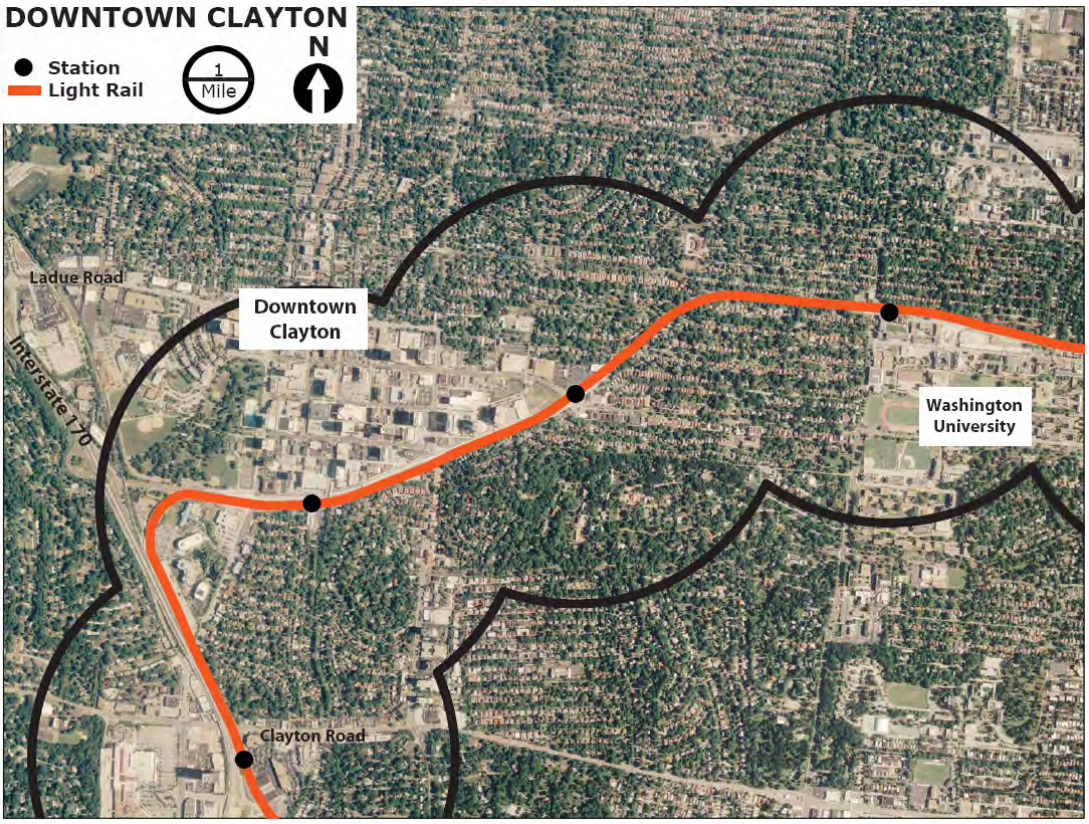
Similarly, the ability of the Southeast Corridor in Denver to allow riders to easily access job opportunities on foot is limited due to its location along the side of an interstate highway. Also, one-half of the station areas are unavailable for TOD development due to barrier represented by the highway. Furthermore, the location of the highway between the station and jobs as well as the lack of good pedestrian connections at

[57] Table 5 shows the ridership and jobs on six of the eight lines we've looked at. In order to compare like info, lines were compared that were constructed and operated as one line. St. Louis and Sacramento's lines blend with existing service and ridership numbers, making the effects hard to compare with the six shown below.

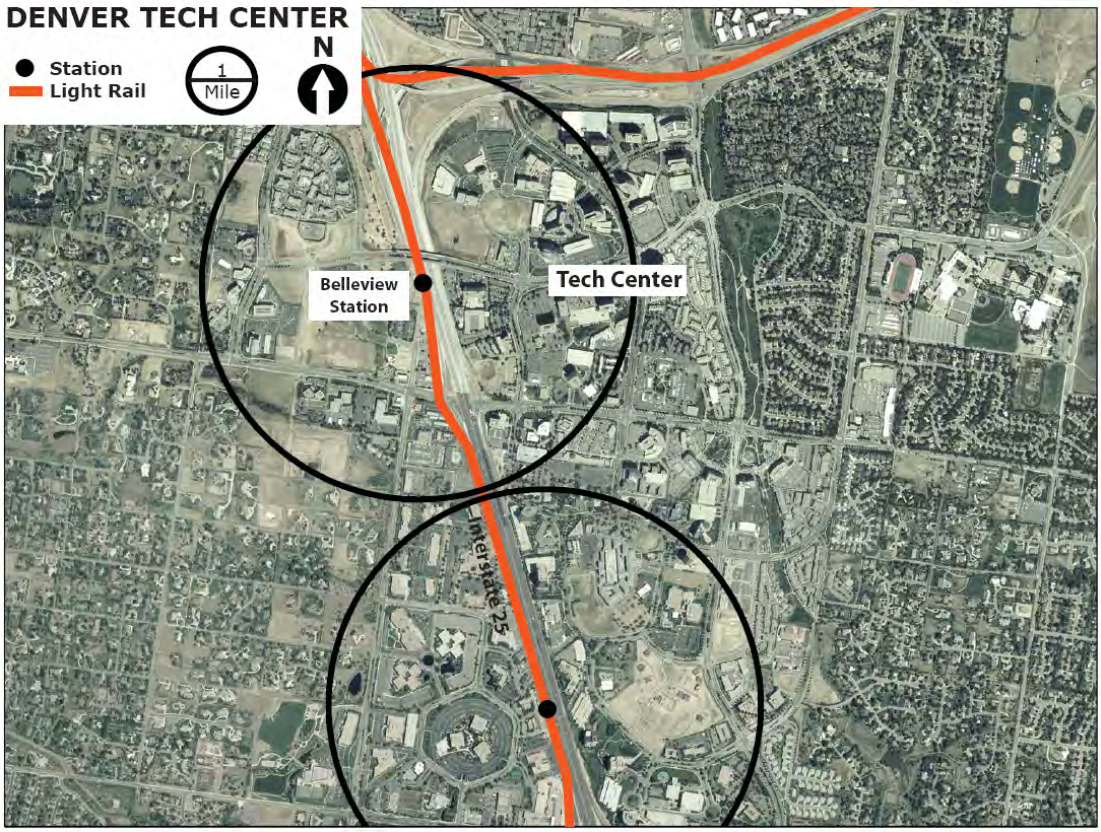
[58] Tom Shrout. Citizens for Modern Transit Advocacy Group. Correspondence 25 May 2007

stations near the Tech Center has been seen as a deterrent to more ridership.[59] Figure 6 below shows the urban context of the Cross County Line in St. Louis and the Southeast Corridor in Denver. Notice in Denver that the high employment density Tech Center is on the opposite side of the freeway from the station. The decision to build the line with the freeway was one that saved money for the transit budget and helped keep the cost-effectiveness rating low.[60], but created the need for "last mile" connections to be made by bridges that cross the busy highway. These last mile connections are often difficult to fund through local public works budgets and make riding transit less comfortable than taking an automobile to work, especially in more suburban employment districts where parking is provided right outside the building.

Figure 6: Downtown Clayton and Denver Tech Center Light Rail Alignments



[59] Denver RTD Staff. Email Correspondence. 5 July 2007. (See Appendix)
[60] USDOT. Innovative Financing Primer. Case Study – GARVEEs. Denver T-Rex Project. April 2002. Accessed <http://www.fhwa.dot.gov/innovativefinance/ifp/ifprimer.pdf >



Source: USDA Aerial Photography, RTD-Denver, Metro St. Louis, CTOD, 2007.

In San Diego, the Green Line was built along side Interstate 8. It is grade separated and the system's first subway station was built at San Diego State University.[61] The decision to build along the highway in mostly elevated structures made the cost considerably higher than if the rail was placed at-grade, but makes travel times along the line faster. With the exception of the subway segment through the University, though, the Green Line delivers patrons to the edge of districts instead of to their centers. A further inconvenience for riders was the decision not to take the line into San Diego's central business district. Initial modeling of the line projected a route to downtown, but now riders must transfer lines in order to continue in to Downtown. As mentioned before, their willingness to transfer has produced more ridership than expected on the whole line, but left the recently constructed Green line stations with less that expected ridership. Emphasizing cost and speed, over connectivity and ease of use for patrons, resulted in less than optimal outcomes.

Figure 7: Sand Diego State University With Green Line Train in Foreground

[61] Jim Linthicum. Director of Engineering and Construction at SANDAG. Email Correspondence 24 May 2007.

Photo by Brad Pennock on Flickr

Houston's Main Street line has drawn local criticism for collisions with drivers who ignored signs, but the routing along a major arterial street is also credited with its success. It runs straight through the largest medical center in the world with over 73,000 jobs[62] and into the downtown of the United States 4th largest city (see figure 8). Local officials say that it was difficult to agree on this alignment, but that the routing has paid large ridership dividends.[63] The Houston light rail line has the highest passenger density per mile of any new light rail line in the United States and does so by going through the center of employment districts rather than skirting them.

Figure 8: Houston Light Rail in the Medical Center

[62] Greater Houston Partnership Website. Health Care Industry Guide Accessed 21 August 2007. <http://www.houston.org/industryGuide/healthCare.asp>

[63] Todd Mason. Houston Metro. Vice President of Real Estate Services. Phone Interview 17 September 2007

Lines in other cities, such as Los Angeles and Sacramento, have built on existing railroad rights-of-way. Using these available lands helps avoid disruption to businesses during construction and expensive land acquisition costs but often serves to skirt major employment centers and destinations. The Gold Line, for example, delivers riders to the outer edge of the Los Angeles CBD, which according to census numbers has over 191,000 jobs. The Gold Line itself is within walking distance of only 120,000 jobs.[64] Most riders have to walk through Union Station and connect to the Red Line Subway to reach their place of employment. . Planning has begun for a downtown connector[65] to connect the Gold Line, Gold Line Eastside and the Blue Line in order to make connections seamless.[66] And, while lines such as these might be adjacent to a significant amount of underutilized property and easily redevelopable uses which could be developed as TOD, the costs of brownfield clean up and providing new infrastructure on these sites might be larger than it would have been if the transit lines were located along arterial corridors with existing water, sewer, and road infrastructure. The federal TSUB model is not calibrated to allow a nuanced assessment of these types of trade-offs.

In some instances, the reason for placing lines in existing rail corridors is that construction impacts to existing users are minimized. Transit projects located in the center of arterial streets, such as Houston's, cause a disruption to businesses during construction and create ancillary costs to reconstruct streets and utilities, and reprogram and replace traffic signals. These costs are often included in the capital transit budget but effectively reduce the "cost effectiveness" rating of a project and are what cause many cities to

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[64] See Table 6.

[65] The downtown connector is envisioned as a subway that would directly connect the Gold line to the Blue Line and the Expo line that terminate on the opposite side of downtown from each other.

[66] LACMTA. Regional Connector Study Page. Accessed 15 February 2008. <http://www.metro.net/projects_programs/connector/default.htm>

look at alternatives to street-running transit through the districts for which it would be most useful. Unfortunately, this "cost shock" causes many cities to choose alignments that do not maximize potential ridership, but serve to lower costs and provide less connected service. [67] This emphasis on cost savings has led many cities to think first about cost and design and impact second.

Destinations Matter when Considering the Destination & Network Connectivity

The second important consideration when choosing alignments is that the destinations themselves matter. Transit lines connecting major universities and regional special events destinations are experiencing significant ridership increase, particularly during the off-peak times. Special event trip generators, universities and regional destinations like airports can each garner significant episodic and long-term transit ridership.[68] The ability of transit to successfully and conveniently transport new riders during these kinds of episodic events can also be influential in generating long-term choice transit riders. And, as discussed previously, where lines are built and their connectivity to other modes of travel as well as employment centers also seems to be an important part of why certain lines attract more ridership. Specific decisions that determine the exact routing of a line can lead to increased or decreased ridership along with possibly increased or decreased cost.

Connectivity to the region and other modes of transportation, including environments friendly to walking, plays an important role too. Subway connections, such as the one at San Diego State University, create a seamless interface between students and the transit line, while disconnects can be created by major highways.

Connections to local bus service can be an important driver of ridership as well. In Portland, local officials believe better connections could have been made to Vancouver Washington bus service.[69] In Houston, the light rail line acts as a spine, connecting to many downtown bus routes and express bus lines that link to the extensive suburban HOV network. The express bus lines have close to 30,000 park-and-ride spaces in 25 lots.[70] In cold-weather climates with lots of snow days, such as Minneapolis, the trains are especially attractive to people who do not want to worry about driving in bad weather conditions.[71]

Network agglomeration is also important. The addition of a single line can create more quick connections with existing networks. In San Diego, a city loop was created with the addition of the Green Line allowing people to travel to destinations along the blue and orange lines without having to route through downtown.[72] In Denver and St. Louis, the new line created a spur from the existing network increasing the connectivity between downtown destinations and employment centers along the line. In Denver specifically, aside from the student ridership gained, off-peak trips to the Denver Tech Center also

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[67] In Austin, Texas for example, a project that will run commuter rail service on existing tracks does not serve the places which need capacity improvements the most. A transit proposal which lost there in a ballot election in 2000, would have served 37,000 riders (2001 FTA New Starts Report) while the current commuter line which serves both ends of the 2000 transit route yet uses existing rail right of way would only serve 2,000 commuters. While the new line costs less and has commuter headways and serves the same end destinations, it misses a lot of the middle.

[68] For many of the studied lines, episodic events actually occur with a high frequency. In St. Louis for example, Metrolink serves three stadiums. In some years there are more than 200 special events in these venues including sporting and other events.

[69] Jillian Detweiler. Tri-Met Senior Land Development Planner. Email Correspondence. 17 August 2007.

[70] Todd Mason. Houston Metro. Vice President of Real Estate Services. Phone Interview 17 September 2007

[71] Dave Van Hattum. TLC Minnesota Advocacy Group. Email Correspondence. 31 May 2007.

[72] Jim Linthicum. Director of Engineering and Construction at SANDAG. Email Correspondence 24 May 2007.

surprised planners.[73] And in St. Louis, the initial network allows riders on the Cross County line to get downtown and to Lambert International Airport.

Recent research has also shown that destinations are major determinants of increases in transit share of work trips. Regression analysis showed in a study of the Twin Cities that for every increase of 1000 people per square mile, transit share to the central city increased by 1.15 percentage points. The central city in his study represents the downtowns of Minneapolis and St. Paul as well as the surrounding close-in job clusters. The same increase in population led to a .63 increase in transit share to suburban jobs. Transit shares to downtown Minneapolis and St. Paul increased 2.43% for each 1000 residents per square mile. Low income residents also increased the share positively for every 1% increase in their numbers.[74] So, when residential densities increase, it matters to which destination people are going as to whether they use transit or not.

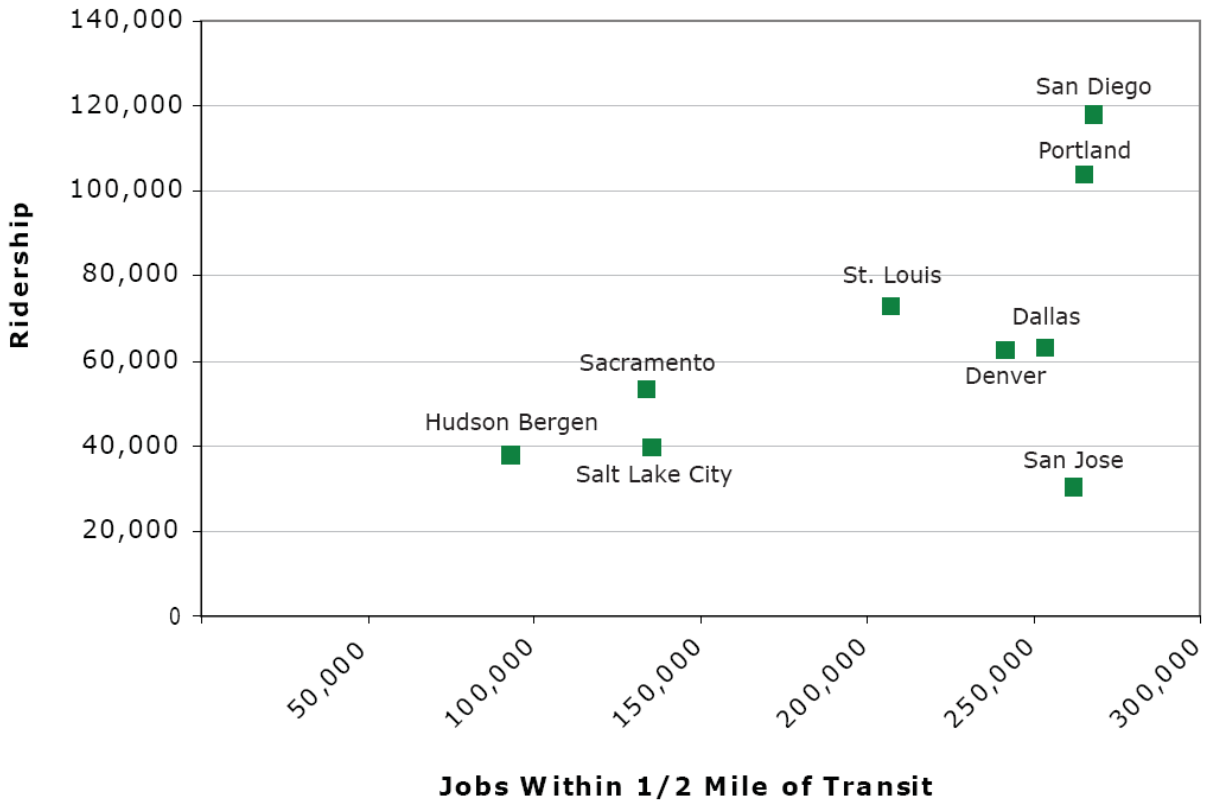
Connecting destinations to create ridership may seem like an obvious conclusion, but plans and policies have not reflected this approach. Most TOD policy have focused on residential development, rather than promoting agglomeration of jobs and commercial space in regional centers served by transit. This points to the fact that destinations, such as major regional centers and downtowns, are serving the most transit riders and their connection to each other would promote higher ridership. Table 6 shows recent transit networks and their connectivity to jobs. There seems to be a correlation between jobs connected and ridership. High job numbers with low ridership in the case of San Jose, can partially be explained by the poor orientation of employment land use to the transit line and vast parking lots available to commuters.

Table 6. Jobs and Ridership of Recently Built Light Rail Systems

Light Rail System	1/2 Mile Jobs	Recent Ridership
San Diego System	267,540	118,400
Portland System	265,136	104,300
San Jose System	261,559	30,400
Dallas System	253,080	63,400
Denver System	241,277	62,900
St. Louis System	206,570	73,200
Salt Lake City System	135,139	39,700
Sacramento System	133,494	53,500
Hudson Bergen System	92,494	38,200

[73] Denver RTD Staff. Email Correspondence. 5 July 2007. (See Appendix)

[74] Barnes, Gary. *Importance of Trip Destination in Determining Market Share.* Journal of Public Transportation Vol 8. No. 2, 2005.



Source: 2004 LEHD, NTD Q4 2007, CTOD

Figure 8. Employment Sprawl in San Jose

Photo Courtesy of Google Earth.

Another issue to consider is the influence of network size and connectivity. It is important to note that new fixed route transit lines often reconfigure bus routes to feed into the higher capacity mode and

extensions of existing networks allow for more connections to a greater number of destinations. Equally important is the impact of network size to achieving multiplier effects as a greater share of people living near a fixed guideway station walk, bike or take transit to work. Excluding the New York CMSA, a statistical outlier, 31% of people that live within a half-mile of a transit station walk, bike or take transit to work. Nationally, this mode split is only 6%. [75]

Figure 9 shows mode split to work for households living within a half-mile of fixed guideway transit stations, compared to the region as a whole. Extensive systems include those with more than 200 stations. Large systems are those between 70-200 stations. Medium systems are classified as having 25 to 69 stations and small systems are those with fewer than 25 stations however they are not represented.

Figure 9: Non Auto Modes to Work, Transit Zones Versus the Region, 2000.

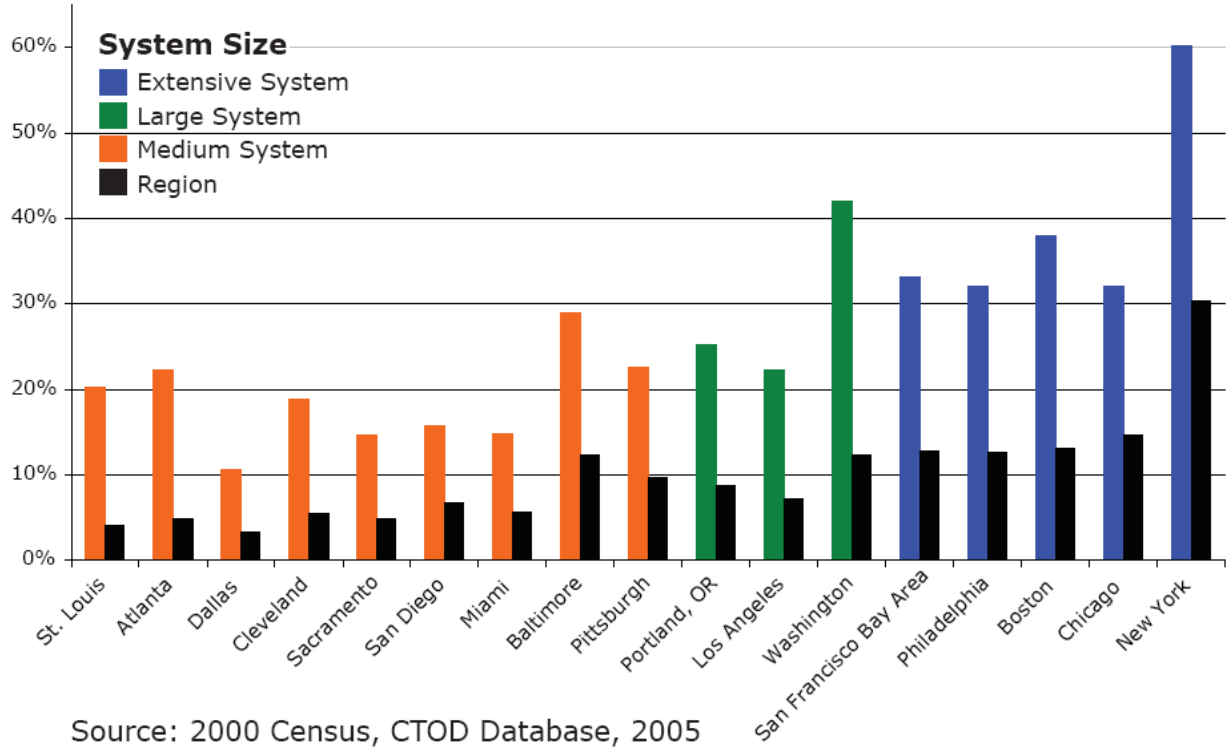


Figure 9 shows that the more extensive the transit system, the greater the influence it has on non-auto modes including walking, biking and transit. In every case, mode split of residents who live near transit is much higher than elsewhere in the region. Not surprisingly, system size also has a profound effect on behavior, as more opportunities can be accessed through transit as the system extends and connects destinations. New York is an example of what can be accomplished when a transit network is able to more closely mimic the connectivity of the road network. Non-auto modes capture 60% of the work trips made by people living within a half-mile of a rapid transit station.

Another topic to consider when discussing travel models, ridership estimates, and land use are the difficulties in measuring the "trip not taken". The trip not taken specifically refers to the decrease in motorized[76] trips due to more efficient transit and land use patterns that allow people to access

[75] National CTOD Station Area Database. Census 2000 Data. Updated November 2005.

[76] There may be a net increase in trips overall, as more non-motorized trips may be made, but for much shorter distances.

destinations without having to drive. The 1994 Portland Travel survey revealed that vehicle miles traveled (VMT) per capita decreased according to specific land use and transit patterns from 21 VMT per day in the most suburban areas to 9.8 VMT per day in areas with good transit connections and mixed-use development. After the construction of the Portland streetcar and addition of over 7,200 housing units along its alignment, it was calculated that these new housing units could account for a reduction of 31.7 million vehicle miles per year given that residents were able to access numerous destinations through walking, transit, or bicycling. Calculating the units against suburban densities, it is possible that 302 acres were saved from development protecting precious farmland or watershed resources. [77]

Conclusions

Given the experiences to date on the eight lines highlighted in this white paper, several conclusions regarding transit ridership can be drawn.

1. Transit Ridership is Increasing and Led by Rail

Transit ridership is increasing and a majority of the increase is coming from investments that had been made over many decades. Light rail ridership is gaining fast with a 117% increase since 1990. Many of these investments have also led to increased walking, biking and pedestrian activity around the stations as evidenced in the mode split charts in the text. This increased walking, biking and transit usage lowers VMT as well as household expenditures, enabling greater affordability and reductions in our usage of costly oil.

2. Transit Investments are Often "Out Performing" Expectations.

New lines such as those in Minneapolis and Houston have already exceeded their 2020 ridership projections and recent start-ups such as in Denver and Charlotte show that this trend is going to continue. More accurate methods for estimating potential ridership would both avoid undercapitalization and help build greater public support for transit investments.

3. Connecting and Bolstering Destinations Should be a Key Strategy to Boost Transit Ridership

Connecting dense employment districts with workers by transit is a powerful way to gain ridership and should be an important consideration for new transit routes and future planning for job centers. While it is important to boost residential densities along new transit lines, it is also important to ensure that they are able to connect to work, shopping or entertainment destinations. Connecting people with the places they want to go by increasing the transit capacity of congested corridors between major destinations will lead to reduced automobile trips and VMT and increased transit ridership.

4. Poor Ridership Forecasting in Either Direction is not Limited to the Federal Program

Accurate ridership projections appear to remain elusive. Many new transit lines are under or over-performing their projections. This ridership swing is not limited to the New Starts program. Houston's line has drastically over-performed, while Los Angeles did not hit its targeted ridership. Both were locally funded. Similarly Minneapolis' line over- performed while Portland and San Diego seem to be on target for their projections. Given the challenge, for a number of reasons, for travel models to predict ridership with a high degree of confidence these models should not receive undue emphasis in the funding evaluation process. Rather, consideration of a broader set of factors may provide a more useful and accurate assessment of the reasons why these transit investments should be made.

5. Improve Analytical Tools to Evaluate Development Impacts

Related to the potential ridership impacts resulting from transit-supportive land use and TOD, is a larger need for more accurately incorporating these kinds of impacts resulting from transit investments. FTA is working to develop an analytical method for evaluating these impacts as part of its Federal rulemaking

[77] E.D. Hovee and Company. *Portland Streetcar Development Impacts*. October 2005.

process for New Starts and Small Starts. Direct ridership forecasting models are also being implemented in several communities, including Salt Lake City and in the Bay Area, to better estimate ridership. These models use multivariate regression based on empirical local data to determine the station characteristics that most influence ridership.[78] But in addition to needing better ridership models, there is a need to expand the tools available to assess the full range of potential land use, economic, and environmental benefits and changes expected from proposed transit projects. This could include a number of analyses including job center analysis performed in this paper.

[78] Transportation consultants Fehr and Peers have developed a direct ridership model proven to have closely estimated actual ridership volumes at the station level. Information on their model can be found at http://www.fehrandpeers.com see "Direct Ridership Forecasting: Out of the Black Box".

APPENDIX

1. Sources

- APTA. 2007 Public Transportation Fact Book. 58th Edition May 2007. The Data is Also Available Online. Accessed 19 Novermber 2007. <http://www.apta.com/research/stats/ridership/trips.cfm>

- APTA NTD Ridership Accessed 8 May 2008. <http://www.apta.com/research/stats/ridership/riderep/documents/07q4lr.pdf>

- Barnes, Gary. *Importance of Trip Destination in Determining Market Share.* Journal of Public Transportation Vol 8. No. 2, 2005.

- Bureau of Transportation Statistics (BTS). National Transportation Statistics: Transit Profile. Accessed 20 February 2008. <http://www.bts.gov/publications/national_transportation_statistics/html/table_transit_profile.html>

- E.D. Hovee and Company. *Portland Streetcar Development Impacts*. October 2005.

- Editorial Staff. *Connecting the Tracks*. Houston Chronicle. 20 October 2007. Accessed 30 October 2007. <http://www.chron.com/disp/story.mpl/editorial/5230480.html>

- Environmental Protection Agency. Building Houston's Competitive Edge: Transit-Oriented Development for the Ensemble/HCC Station. 27 October 2006. Available Online < http://www.epa.gov/smartgrowth/pdf/houston.pdf>

- Federal Transit Administration Office of Planning and Environment. *FY 2009 New Starts and Small Starts Evaluation Process*. 20 July 2007. <http://www.fta.dot.gov/documents/FY_2009_Eval_Process.doc>

- Federal Transit Administration, Office of Environment and Planning, *Proposed Policy Guidance on Evaluation Measures for New / Small Starts.* US Department of Transportation, August 3, 2007.

- Federal Transit Administration, Office of Planning and Environment. *Contractor Performance Assessment Report*. September 2007. <http://www.fta.dot.gov/documents/CPAR_Final_Report_-_2007.pdf>

- Federal Transit Administration, Office of Planning and Environment. *Proposed Guidance on New Starts/Small Starts Policies and Procedures*, February 5, 2007. US Department of Transportation.

- Federal Transit Administration. *Discussion Piece 6:Predicted vs. Actual Ridership of Proposed New Starts Projects*. 6 June 2006. <www.fta.dot.gov/documents/Discussion_6_Predicted_and_Actual.doc>

- Federal Transit Administration. *Contractor Performance Assessment Report* September 2007 <http://www.fta.dot.gov/documents/CPAR_Final_Report_-_2007.pdf>

- Federal Transit Administration. Annual Report on New Starts: 1997 to 2008. Accessed 10 October 2007. <http://www.fta.dot.gov/planning/newstarts/planning_environment_2618.html>

- Federal Transit Administration. Annual Report on New Starts: 1998 San Diego California, Mission Valley East LRT. Accessed 10 October 2007 <http://ntl.bts.gov/lib/7000/7600/7625/chapters/SD-Mission_Valley_East.html>

- Federal Transit Administration. Annual Report on New Starts: 2001 Denver Colorado, Southeast Corridor LRT. Accessed 10 October 2007. <http://www.fta.dot.gov/printer_friendly/planning_environment_2925.html>

- Federal Transit Administration. Annual Report on New Starts: 2001 Interstate Max LRT Extension. Portland, Oregon. Accessed 10 October 2007. <http://www.fta.dot.gov/publications/reports/planning_environment_2941.html>

- Federal Transit Administration. Annual Report on New Starts: 2001. Accessed 15 February 2008. <http://www.fta.dot.gov/publications/reports/reports_to_congress/planning_environment_2915.html>

- Federal Transit Administration. Annual Report on New Starts: 2002 Appendix A. Downtown to Astrodome Light Rail. Houston, Texas. Accessed 10 October 2007. <http://www.fta.dot.gov/printer_friendly/planning_environment_3165.html>

- Goetzke, Frank. Network Effects in Public Transit Use: Evidence from a Spatially Autoregressive Mode Choice Model for New York. *Urban Studies*, February 2008.
- Greater Houston Partnership Website. Health Care Industry Guide Accessed 21 August 2007. <http://www.houston.org/industryGuide/healthCare.asp>

- July San Diego Trolley Ridership Report. July 2007

- LACMTA Monthy Ridership Updates . Accessed 10 November 2007 <http://www.metro.net/news_info/ridership_avg.htm>

- LACMTA. Regional Connector Study Page. Accessed 15 February 2008. <http://www.metro.net/projects_programs/connector/default.htm>

- Metrolink Press Release. 14 August 2007 (See Appendix)

- National CTOD Station Area Database. Census 2000 Data. Updated November 2005.

- Portland Transport . Better Late than Never. Blog Post. 1 November 2007. <http://portlandtransport.com/archives/2007/11/better_late_tha_1.html>

- Reconnecting America, *Realizing the Potential: Expanding Housing Opportunities Near Transit*. April 2007.

- Reconnecting America. Finding the Balance, Realizing the Potential Report: Minneapolis Case Study. April 2007. Available Online. <http://www.reconnectingamerica.org/public/download/rtp10>

- RTD Denver Press Release. 16 November 2007. (See Appendix)

- RTD Press Release, 17 November 2007 (See Also Appendix)

- RTD-Fastracks – Transit-Oriented Development 2006 Status Report. February 2007. Available Online. <http://www.rtd-fastracks.com/media/uploads/main/TODStatusReport2006.pdf>

- SANDAG. September Trolley Ridership Report. Received 8 October 2007.(See Appendix)

- Strategic Economics. Metro Gold Line Foothill Extension: Market Conditions and Opportunities for TOD. January 2008.

- TRB Light Rail Conference Circular. Actual Versus Forcast Ridership on Metrolink in St. Claire County Illinois. Accessed 28 April 2008. <http://pubsindex.trb.org/document/view/default.asp?lbid=700151>

- USDOT. Innovative Financing Primer. Case Study – GARVEEs. Denver T-Rex Project. April 2002. Accessed < http://www.fhwa.dot.gov/innovativefinance/ifp/ifprimer.pdf >