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The Influence of Service Planning Decisions on Rail Transit Success or Failure

MTI Report 08-04

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THE INFLUENCE OF SERVICE PLANNING DECISION ON RAIL TRANSIT SUCCESS OR FAILURE

June 2009

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16. Abstract

Some United States metropolitan areas with rail transit systems enjoy ridership and productivity success while others do not. This study examines the experiences of 11 U.S. metropolitan areas with between onr million and five million persons to better understand why some areas are successful and others are not. A particular focus is the role of service planning decisions in facilitating transit success. We find that successful transit systems are those that: 1) articulate a clear, multidestination vision for regional transit; 2) rely on rail transit as the system's backbone; 3) recognize the importance of the non-CBD travel market; 4) encourage the use of transfers to reach a wider array of destinations; 5) recognize that rail transit alone is not enough to guarantee success; and 6) recognize the importance of serving regional destinations.

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EXECUTIVE SUMMARY

This investigation of the role of service planning decisions in promoting rail transit success or failure focused on the experiences of eleven metropolitan areas with between 1 million and 5 million persons that have rail transit. These metropolitan areas include: Atlanta, Georgia; Dallas-Fort Worth, Texas; Denver, Colorado; Miami, Florida; Minneapolis-St. Paul, Minnesota; Pittsburgh, Pennsylvania; Portland, Oregon; Sacramento, California; Salt Lake City, Utah; San Diego, California; and San José, California. The authors collected and examined a combination of documentary evidence and statistical data, and conducted interviews with key informants in each study area. The resulting case study narratives are included as appendices in this project's report.

The authors define a rail transit system as having been successful if it has contributed in a favorable way to metropolitan transit riding habit and service productivity. Riding habit refers to the number of passenger miles per capita for the combined set of transit agencies in a metropolitan area. Service productivity refers to load factor, the ratio of passenger miles to vehicle miles, for the combined set of transit agencies in a metropolitan area. For this study's purposes, riding habit success means that transit patronage (measured as passenger miles) is keeping pace with or exceeding population growth. Service productivity success means that a metropolitan area's transit agencies are experiencing either productivity increases or productivity declines less severe than the national average (nationally, service productivity fell 14% from 1984 to 2004).

Based on these definitions, two metropolitan areas emerge from the analysis of transit performance as unqualified successes: Portland and San Diego. Portland is clearly a success. It ended the period with the largest riding habit while also experiencing the largest percentage growth in riding habit. It also experienced a very large increase in productivity, ending up with the second most productive transit among the cases.

San Diego also is a success. Its riding habit increased by almost 30 percent, ending the period almost tied with Denver and Atlanta, but lower than Portland and Miami. Its productivity, relatively high to begin with, also improved, but only slightly. All of this is despite San Diego slipping significantly from 2002 through 2004 in both riding habit and productivity. (San Diego today likely is higher on both these counts. The authors obtained special passenger tallies from 2003 through 2007, showing very strong ridership growth between 2004 and 2007 inclusive of all its modes, as discussed in the case study.)

The other metropolitan areas offer a more mixed record. In general, those metropolitan areas that have a more multidestination vision and have leveraged their rail investments to bring about that vision (San Diego, Portland, Miami, and Atlanta) have been the most productive. They also have enjoyed the best record in riding habit. Those metropolitan areas with relatively minor rail services set in a system with a central business district (CBD)-express bus focus (Pittsburgh and Minneapolis-St. Paul) have lower overall regional transit productivity and less encouraging riding habits.

Those metropolitan areas that have introduced very good rail services but have continued to operate bus services in competition with them (Salt Lake City and Sacramento in terms of its more recent rail extensions, and Pittsburgh) generally have obtained good results for their rail lines but poor results with their bus systems, with an overall depressing effect on regional transit performance. These systems generally have viewed bus and rail systems as competitive, and they let the passenger decide what mode of transit is best for their particular trip. The result has been duplicative service between many suburban points and the CBD and the absence of service, or very inconvenient service to other destinations. This condition has produced low productivity primarily for the bus services.

Overall, this study's analysis indicates that the most successful metropolitan areas have deployed rail transit as the backbone of an integrated, multidestination bus-rail transit system that provides the passengers with the ability to access an array of regional destinations. The analysis revealed a number of principles that underlie rail transit success. The key principles are as follows:

1. Successful transit systems articulate a clear, multidestination vision for regional transit.

A multidestination vision is premised on the notion that the transit market consists of a mix of passengers traveling for varying purposes at different times of the days to many different parts of the metropolitan area. Metropolitan areas that embrace this vision disperse their service throughout their networks. In these networks, rail lines replaced many of the bus routes that formerly traveled to the CBD. Bus routes tend to be more focused on rail stations in the suburbs, both feeding passengers to CBD-bound trains, but also distributing train passengers to suburban destinations. Transfers are important, designed to expand the number of destinations that passengers may reach. In such systems, rail lines sometimes function as regional distributor lines, absorbing passengers from connecting bus services in the suburbs and distributing these passengers to important destinations or to important bus transfers in many parts of the regions.

The authors' analysis indicates that the most successful metropolitan areas embraced the multidestination service philosophy and applied it on a regional scale. In the most successful metropolitan areas, transit patrons can use a combined bus-rail transit system to easily reach a wide array of destinations both inside and outside the CBD. Less successful metropolitan areas do not present the same array of travel options to their patrons. Some focus most of their service on the CBD, which is a declining activity center. Others do not integrate their bus and rail services to feed one another. Still others embrace an integrated, multidestination vision, but apply it on a less-than-regional scale. In each of these cases, the net result is lower riding habit and service productivity, in short lower transit performance, than the region might otherwise have enjoyed.

2. Successful transit systems rely on rail transit as the system's backbone.

The most successful metropolitan areas rely heavily on rail transit as the backbone to the metropolitan transit system. In these areas, rail carries a disproportionate share of riders compared to the proportion of service that it represents. It does so not only because of its higher carrying capacity than bus, but also because it plays an important role moving passengers throughout the larger transit network. In metropolitan areas like Atlanta, for example, the rail system serves as a trunk line, and the extensive bus network serves as a feeder and distribution system for the region.

The authors' analysis indicates that the most successful metropolitan areas use rail transit as a backbone for their regional transit systems, around which they restructure their bus network. The rail then serves as a trunk line and the bus network as feeders and distributors for a system that provides riders with service to an array of travel destinations throughout the metropolitan area. Much less successful is an approach where rail is a minor part of a larger CBD express bus based vision. Metropolitan areas that have adopted this approach have experienced lower-than-expected and/or declining patronage—even in corridors similar to those where rail has seen high or increasing patronage.

3. Successful transit systems recognize the importance of the non-CBD travel market.

Most transit agencies have long regarded the CBD as an important focal point for their transit service, and the widespread incidence of CBD-radial transit networks attests to the continuing popularity of this philosophy. However, the most successful metropolitan areas make a conscious effort to serve non-CBD destinations, because those are the parts of the metropolitan area that are growing and contain most of the destinations transit patrons wish to reach.

The authors' analysis indicates that non-CBD bound riders make up a sizable share of patronage on even CBD-focused transit services. Thus, serving non-CBD markets is even more critical than one might have initially expected. These non-CBD destinations represent the major destinations patrons wish to reach, and they are also the areas of growth in each metropolitan area. The CBDs, by contrast, are in most cases stagnant or in decline.

4. Successful transit systems encourage the use of transfers to reach a wider array of destinations.

The use of transfers makes it possible for transit systems to serve a wider array of origins and destinations in dispersed metropolitan areas than can be served by one-seat-ride, point-to-point service. Transfers help extend the geographic reach of the transit system.

The authors' analysis shows that successful transit systems take advantage of the potential for smooth transfers to broaden the array of potential destinations that their passengers can reach. These systems make it easy for their passengers to transfer by timing the connections to minimize wait time, and thus reducing the time penalty associated with transfers. They provide free transfer rights for their riders to reduce the financial penalty associated with transfers. Less successful transit systems do not do these things. They either attempt to avoid transfers by providing one-seat-ride service to a much smaller set of destinations, and/or they make it difficult and inconvenient for their riders who must transfer.

5. Successful transit systems recognize that rail transit alone is not enough to guarantee success.

The most successful transit systems take a comprehensive approach to rail transit planning that focuses on providing passengers with easy access to the rail service, often through an array of modes. The service is located in a corridor that allows rail transit, and its bus connections, to link the major activity centers to which patrons wish to travel. These principles are followed by successful rail transit systems in San Diego, Portland, and Atlanta.

The authors' analysis shows that simply placing rail transit in corridors that are collocated with major activity centers is not sufficient to guarantee ridership success. It is necessary to carefully plan how riders will access and egress the rail transit system and then reach their final destination. It is also important to provide high-speed, high-frequency service. The analysis also shows that using rail transit as an economic redevelopment tool may result in lower-than-anticipated ridership when the development fails to materialize. This happens when the line is built in a corridor where development makes no economic sense, regardless of planning measures to stimulate it, as was the case in Miami. The development that Miami Metrorail was supposed to stimulate in the depressed sector of northwest Miami never materialized, and patronage from that corridor never materialized either.

On the other hand, extending rail transit into a corridor that is "hot" for development from the perspective of both the market and regional planning priorities can result in complementary development occurring around rail transit stations. This has been the case in Portland's Washington County and to a lesser extent in San Diego's Mission Valley.

6. Successful transit systems recognize the importance of serving regional destinations.

One of the most important lessons from the case studies is that successful transit systems seek to serve all of the region's major activity centers. These activity centers represent the destinations to which people wish to travel, and failure to serve these centers with high-quality service places transit at a competitive disadvantage versus the automobile. In metropolitan areas where significant activity centers are not served, the result has been diminished riding habit and productivity.

The authors' analysis clearly indicates that the most successful transit systems provide high-quality service to the array of major activity centers throughout the region. The rail system serves as a backbone for the regional transit service strategy. Less successful systems either serve only a limited portion of the region or prioritize serving one major activity center, the CBD, despite the fact that this center is in relative decline in nearly all the study areas. As the discussion of Atlanta indicates, extending the reach of a successful sub-regional system to an entire region is not an overwhelming task from a logistical and planning perspective, although in certain settings it may require a vote of the electorate or legislative action.

INTRODUCTION

Between 1980 and 2005, sixteen U.S. metropolitan areas opened rail transit systems. These metropolitan areas joined ten others whose rail transit systems predate the recent rail transit renaissance.[1] Some of these rail transit metropolises have enjoyed increased riding habit and/or service productivity in recent years, while others have experienced stagnant or declining riding habit and/or service productivity. The purpose of this research is to understand why some metropolitan areas with rail transit have experienced transit performance success and others have not done so. The specific focus of this research is to better understand the role that service planning decisions have played in rail transit success or failure.

The eleven metropolitan areas that we examine in this report have both bus and rail transit services. But the various metropolitan areas' transit agencies have approached the planning of these two parts of the transit system very differently. In some metropolitan areas, transit agencies use both modes, and the ability for passengers to transfer between them, to expand the geographic reach of the transit system. In other metropolitan areas, transit agencies have focused, as much as possible, on providing one-seat rides between suburban residential districts and a primary activity center, generally the central business district. In some metropolitan areas, transit agencies restructured their bus systems once they opened their rail transit investment. In other metropolitan areas, transit agencies did not significantly change their bus systems when the rail transit opened.

Through this research, the authors have assessed the effects of the various service strategies the transit agencies have pursued, while also taking into account the roles played by metropolitan population and employment trends, urban structure, and transportation-land use policies (including transit-oriented development) as influences on rail transit success or failure. Our hypothesis is that service planning decisions are important determinants of ridership and productivity success that most scholarly and practitioner literature has tended to overlook.

The authors defined a rail transit system as having been successful if it has contributed in a favorable way to overall transit riding habit and service productivity. Riding habit refers to the number of passenger miles per capita for the combined set of transit agencies in a metropolitan area. Service productivity refers to load factor, the ratio of passenger miles to vehicle miles, for the combined set of transit agencies in a metropolitan area. For the purposes of this study, riding habit success means that transit patronage (measured as passenger miles) is keeping pace with or exceeding population growth. Service productivity success means that a metropolitan area's transit agencies are experiencing either productivity increases or productivity declines less severe than the national average (nationally, service productivity fell 14% from 1984 to 2004).[2]

Transit Performance in MSAs with 1 Million to 5 Million Persons

Prior to undertaking this research, the authors examined transit performance trends between 1984 and 2004 in all 45 U.S. metropolitan statistical areas (MSA) with year 2000 populations between 1 million and 5 million.[3] They selected this population range because it includes most of the recent additions to the ranks of the rail transit metropolises. This population class excludes larger metropolitan areas such as New York, Chicago, and Philadelphia, whose urban development and transit development histories are quite different from those of most other metropolitan areas. The 1 million to 5 million population class is also the locale for much of the recent urban population growth in the United States. This class includes many non-rail cities that may be considering investing in rail transit.

The authors stratified the 45 metropolitan areas based on their classification on two variables. First, they distinguished between metropolitan areas that had bus-only transit systems and those with combined bus-rail systems. Second, they distinguished between metropolitan areas on the basis of their service orientation. Service orientation refers to the way a transit agency structures its service. A transit agency manager can concentrate service on the central business district (CBD) or disperse service to connect multiple destinations. The first approach represents a radial service orientation, whereas the second represents a multidestination service orientation. Here, they examined the percent of transit routes that served the CBD and classified the metropolitan areas as either radial (those with more than 55% of bus routes serving the CBD) or multidestination (those with fewer than 55% of bus routes serving the CBD). The authors chose 55% because it is a number slightly above 50%, or half of the area's transit routes. Combining these two classification schemes results in four groups of metropolitan areas: multidestination bus-and-rail, multidestination bus-only, radial bus-and-rail, and radial bus-only. The metropolitan areas contained in each of the four groups are shown in Table 1.

To undertake the transit performance analysis, the authors aggregated the transit data from all transit agencies in each metropolitan area to produce metropolitan-level performance measures. They examined the performance of each metropolitan area between 1984 and 2004 on two measures: riding habit (passenger miles per capita) and service productivity (passenger miles per vehicle mile). They also examined the performance of the four MSA groups (stratified as discussed above) on each of these performance measures. The authors used the median value as the measure of overall group performance.

Table 1 Classification of 45 study MSAs

Multidestination MSAs			
Bus Only (in 2004)	**% Non-CBD Routes**	**Bus and Rail (in 2004)**	**% Non-CBD Routes**
Las Vegas	73.58	Atlanta	75.00
Milwaukee	48.53	Dallas	61.08
Norfolk	49.18	Denver	58.70
Phoenix	61.36	Miami	67.61
Rochester	45.00	New Orleans	50.50
San Antonio	45.00	Portland	56.82
		Sacramento	69.05
		St. Louis	54.55
		San Diego	81.87
		Seattle	53.88
Radial MSAs			
Bus Only	**% Non-CBD Routes**	**Bus and Rail (in 2004)**	**% Non-CBD Routes**
Albany	9.52	Buffalo	34.92
Austin	22.86	Cleveland	39.68
Birmingham	5.41	Hartford	6.90
Charlotte	27.16	Houston	38.32
Cincinnati	7.14	Jacksonville	23.81
Columbus	24.14	Memphis	20.90
Dayton	23.53	Minneapolis-St. Paul	34.80
Grand Rapids	21.74	Pittsburgh	21.33
Greensboro	16.39	Salt Lake City	42.42
Greenville	0.00		
Indianapolis	7.14		
Kansas City	40.82		
Louisville	29.63		
Nashville	0.00		
Oklahoma City	16.13		
Orlando	43.75		
Providence	29.31		
Raleigh	22.89		
Richmond	9.62		
Tampa	33.33		

Source: Brown and Thompson, 2008

Table 2 presents the results of our investigation of riding habit (passenger miles per capita). The table reports riding habit by MSA for 1984, 2004, and the percent change in riding habit between 1984 and 2004. The left panel of the table presents performance statistics for multidestination MSAs and the right panel reports does so for radial MSAs. The top half of the table reports performance statistics for bus-and-rail MSAs and the bottom half of the table does so for bus-only MSAs. Underneath each MSA group panel, the table reports the median value for the group in 1984 and 2004 and the median percent change (1984–2004).

The table shows that the multidestination MSA groups enjoyed higher riding habit than the radial MSA groups in 1984 and 2004, and over time between 1984 and 2004. The bus-and-rail MSA groups enjoyed higher riding habit than the bus-only MSA groups in 1984, in 2004, and over time between 1984 and 2004. The median MSA in three of the four groups (multidestination bus-only, radial bus-and-rail, and radial bus-only) experienced decreased riding habit between 1984 and 2004. The exception to this pattern is the multidestination bus-and-rail group (shown in the top left table panel). The median MSA in this group enjoyed the best riding habit performance of all the groups in 1984 (128.4), in 2004 (148.9), and over time between 1984 and 2004 (+8.8%). In the median MSA in this group, riding habit increased faster than population between 1984 and 2004.

Within the multidestination bus-and-rail MSA group, there is considerable variation in riding habit change between 1984 and 2004. One potential explanation for this variation in riding habit change relates to the use transit agencies in each MSA make of their rail transit investments in the context of the overall regional transit network. This is, in fact, a focus of this project's research. Most MSAs within the group introduced rail transit some time during the study period (including Dallas, Denver, Miami, Portland, Sacramento, Saint Louis, and Seattle).

Table 3 presents the results of the authors' investigation of service productivity (passenger miles per vehicle mile). The table is organized in the same manner as Table 2. As was true in the case of riding habit, the best performing MSAs were the multidestination bus-and-rail MSAs. Using the median MSA as the means of comparison, the table shows that these MSAs enjoyed the highest productivity among the four groups in 1984 and in 2004 (11.3 and 9.3, respectively) and also experienced the smallest productivity decline between 1984 and 2004 (-12.7%). The productivity decline among the multidestination bus-and-rail MSAs was about one-half the productivity decline in the radial bus-and-rail MSAs (-25.4%), suggesting that multidestination service orientation is a significant explanation for better transit productivity.

This suggestion is strengthened by the performance of the multidestination bus-only MSAs. These were the second best performers in 2004 (after ranking third among the groups in 1984) and saw productivity decline only slightly more than for their bus-and-rail counterparts (-15.3%). By contrast, the radial MSAs (both bus-only and bus-and-rail) saw productivity declines in excess or 25% between 1984 and 2004.

Interestingly, nine MSAs experienced service productivity increases between 1984 and 2004, and three of these MSAs possessed high productivity transit systems (load factors greater than 10) in 2004. Two of the three MSAs (Portland and San Diego) are in the multidestination bus-and-rail group, while the third (Las Vegas) is in the multidestination bus-only group.

Table 2 Riding habit (passenger miles per capita) in 45 MSAs

Multidestination Bus and Rail MSAs	1984	2004	Percent Change (1984–2004)	Radial Bus and Rail MSAs	1984	2004	Percent Change (1984–2004)
Atlanta	173.06	149.07	-13.86	Buffalo	82.21	56.53	-31.23
Dallas	63.33	66.12	4.40	Cleveland	144.50	94.57	-34.56
Denver	131.74	149.01	13.11	Hartford	68.50	59.43	-13.24
Miami	125.14	163.80	30.90	Houston	97.41	99.28	1.92
New Orleans	161.51	94.92	-41.23	Jacksonville	55.01	48.28	-12.23
Portland	161.89	223.71	38.19	Memphis	40.87	55.85	36.66
Sacramento	74.41	67.66	-9.07	Minneapolis-St Paul	105.62	86.36	-18.24
St. Louis	71.66	91.72	28.00	Pittsburgh	130.46	116.43	-10.75
San Diego	117.19	148.87	27.03	Salt Lake City	70.66	80.66	14.15
Seattle	203.13	198.06	-2.49				
Median	*128.44*	*148.94*	*8.76*	Median	*82.21*	*80.66*	*-12.23*
Multidestination Bus Only MSAs	**1984**	**2004**	**Percent Change (1984–2004)**	**Radial Bus Only MSAs**	**1984**	**2004**	**Percent Change (1984–2004)**
Las Vegas	22.67	107.05	372.17	Albany	53.40	45.90	-14.05
Milwaukee	143.49	101.99	-28.93	Austin	60.16	80.02	33.02
Norfolk	53.06	51.32	-3.26	Birmingham	21.32	17.13	-19.64
Phoenix	40.16	53.49	33.20	Charlotte	22.23	36.68	65.02
Rochester	53.67	39.13	-27.10	Cincinnati	81.42	72.40	-11.08
San Antonio	101.14	82.84	-18.09	Columbus	82.39	25.15	-69.48
				Dayton	85.99	41.61	-51.61
				Grand Rapids	16.37	17.03	4.04
				Greensboro	11.67	9.50	-18.65
				Greenville	4.46	4.94	10.69
				Indianapolis	44.54	22.82	-48.76
				Kansas City	33.83	25.74	-23.92
				Loiusville	86.59	40.42	-53.32
				Nashville	34.97	20.15	-42.39
				Oklahoma City	12.52	16.75	33.80
				Orlando	27.24	68.62	151.96
				Providence	55.51	55.07	-0.78
				Raleigh	15.96	27.64	73.13
				Richmond	69.86	29.39	-57.93
				Tampa	38.64	38.82	0.48
Median	*53.36*	*68.16*	*-10.68*	*Median*	*36.80*	*28.51*	*-12.56*

Source: Brown and Thompson, 2008.

Table 3 Service productivity (passenger miles per vehicle mile) in 45 MSAs

Multidestination Bus and Rail MSAs	1984	2004	Percent Change (1984–2004)	Radial Bus and Rail MSAs	1984	2004	Percent Change (1984–2004)
Atlanta	13.88	13.79	-0.72	Buffalo	10.23	6.49	-36.61
Dallas	11.86	8.60	-27.50	Cleveland	14.21	7.97	-43.95
Denver	9.17	7.47	-18.51	Hartford	10.24	6.77	-33.93
Miami	11.38	10.34	-9.13	Houston	9.81	9.56	-2.62
New Orleans	14.64	8.68	-40.72	Jacksonville	7.56	5.64	-25.44
Portland	8.41	12.25	45.53	Memphis	6.67	8.18	22.61
Sacramento	11.35	9.14	-19.52	Minneapolis-St . Paul	9.70	8.19	-15.63
St. Louis	7.77	9.16	17.92	Pittsburgh	10.05	7.18	-28.59
San Diego	10.95	11.15	1.77	Salt Lake City	6.05	5.56	-8.11
Seattle	11.21	9.38	-16.29				
Median	11.28	9.27	-12.71	Median	9.81	7.18	-25.44
Multidestination Bus Only MSAs	**1984**	**2004**	**Percent Change (1984–2004)**	**Radial Bus Only MSAs**	**1984**	**2004**	**Percent Change (1984–2004)**
Las Vegas	10.90	11.23	3.05	Albany	9.15	6.97	-23.83
Milwaukee	9.29	7.19	-22.64	Austin	7.24	6.98	-3.55
Norfolk	8.31	7.65	-7.96	Birmington	6.83	5.98	-12.50
Phoenix	8.88	6.29	-29.18	Charlotte	9.46	6.90	-27.02
Rochester	8.97	6.59	-26.45	Cincinnati	9.95	9.11	-8.45
San Antonio	8.59	8.01	-6.74	Columbus	12.75	4.81	-62.27
				Dayton	12.96	5.56	-57.12
				Grand Rapids	5.63	5.73	1.79
				Greensboro	8.57	4.92	-42.63
				Greenville	5.42	7.00	33.73
				Indianapolis	10.66	6.31	-40.76
				Kansas City	6.59	4.74	-28.03
				Louisville	11.96	6.47	-45.89
				Nashville	8.53	5.28	-38.13
				Oklahoma City	4.80	5.11	6.46
				Orlando	7.22	9.37	29.93
				Providence	8.72	7.19	-17.55
				Raleigh	6.18	4.55	-26.29
				Richmond	11.57	5.96	-48.50
				Tampa	8.26	5.99	-27.52
Median	*8.92*	*7.42*	*-15.30*	Median	8.55	5.98	-26.65

Source: Brown and Thompson, 2008.

Transit Performance in Eleven Metropolitan Areas

The descriptive examination presented above suggests that transit agencies in multidestination bus-and-rail metropolitan areas are making planning decisions that lead to better performance outcomes than their radial counterparts. The authors explored this issue in more detail by looking closely at eleven metropolitan areas in the 1 million to 5 million population class that have bus and rail transit systems. These metropolitan areas are located in different parts of the United States. The authors selected eight multidestination metropolitan areas and three radial metropolitan areas. The eight multidestination metropolitan areas are Atlanta, Dallas, Denver, Miami, Portland, Sacramento, San Diego, and San José. (San José is included in the set of multidestination MSAs because fewer than 55% of its bus routes serve the San José CBD.) All of these metropolitan areas, save San José, were included in the descriptive examination discussed earlier. In the earlier study, San José was considered part of the consolidated San Francisco Metropolitan Statistical Area, a region whose aggregated population was outside of the 1 to 5 million population range of metropolitan areas we examined. The three radial metropolitan areas are Minneapolis, Pittsburgh, and Salt Lake City.

These eleven metropolitan areas have experienced very different trends with respect to riding habit and service productivity in recent years. Figure 1 graphs riding habit for each of the eleven metropolitan areas for every year from 1984 to 2004. The figure shows wide variation among the metropolitan areas with respect to the magnitude of riding habit and both the magnitude and direction of riding habit change. Particularly striking are the divergent trends among the metropolitan areas. Portland, for example, enjoyed high riding habit in 1984 and experienced increased riding habit since that time. Other metropolitan areas, including Minneapolis, Pittsburgh and San José, had moderate riding habit in 1984 but have experienced falling riding habit since that time.

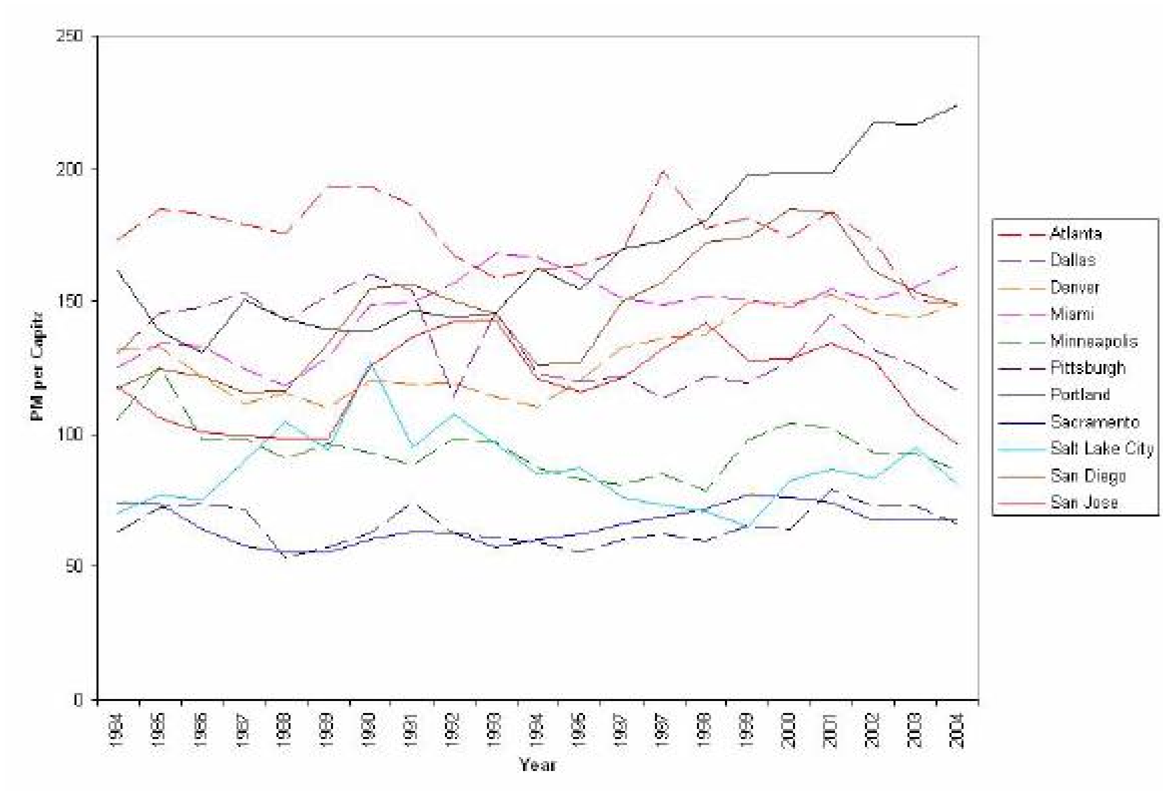


Figure 1 Riding habit for 11 metropolitan areas

Figure 2 graphs service productivity for the set of eleven metropolitan areas over the same time period. As was true for riding habit, the figure shows considerable variation in service productivity among the metropolitan areas. Most metropolitan areas experienced declining productivity over the period, but they began the period with very different levels of service productivity. Three metropolitan areas stand out as having begun with high service productivity in 1984 and experienced stable or increased service productivity since that time. These three metropolitan areas are Atlanta, Portland, and San Diego. The latter two metropolitan areas increased their service productivity over this time, with Portland increasing service productivity in excess of 40%. On the other hand, there are metropolitan areas that began with low productivity and experienced productivity declines. These metropolitan areas include Minneapolis, Salt Lake City, and San José. Dallas and Pittsburgh are also noteworthy for their productivity declines.

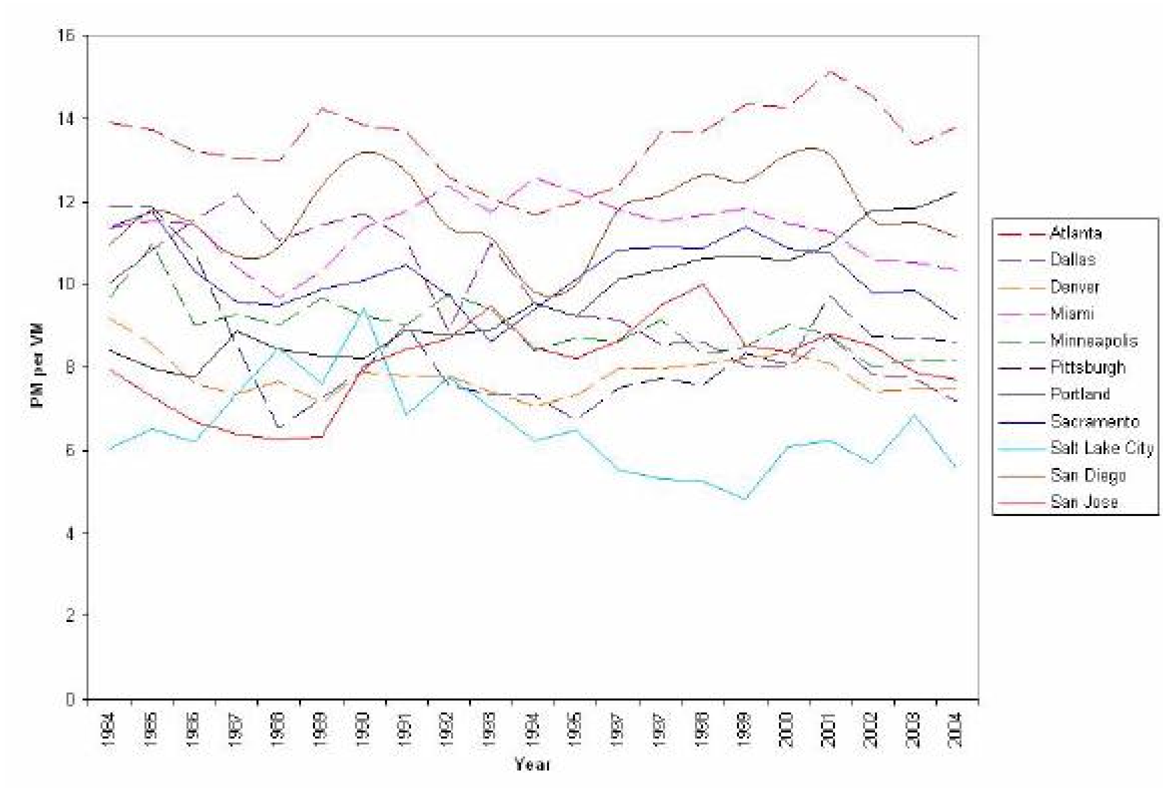


Figure 2 Service productivity for 11 metropolitan areas (1984–2004)

The purpose of this research is to understand the reasons for the trends shown in Figure 1 and Figure 2. In particular, the authors wanted to understand the roles that service planning decisions played in affecting these trends. All eleven metropolitan areas have both bus and rail transit systems today, but the rail systems were introduced, expanded, or modernized at different times during the study period for each metropolitan area, and transit system decision makers in each area used the rail lines and bus services in different ways to change transit mobility in their regions.

The outcomes in terms of overall performance of the respective transit systems have varied widely. What explains this variation? Do service planning decisions play a role in explaining the variation in performance? What lessons can be drawn from both positive and negative experiences? How should these lessons influence service planning decisions in other cities that have (or are contemplating) rail transit investments? The authors discussed all of these questions, and numerous others, in the course of this investigation. It is their hope that the discussion presented in this volume will be of practical benefit to transit planners and managers and of scholarly benefit to other researchers attempting to better understand the role transit does (and can) play in today's increasingly decentralized urban environments.

The authors purposefully titled one section of the report a Guidebook in the hope that its contents can be of direct practical benefit to transit industry policymakers and planners. It is written in a way that facilitates its use as a stand-alone document. The Guidebook highlights the key lessons from the detailed individual case studies contained in the first eleven report appendices. These case studies themselves tell interesting stories about the different approaches to transit planning and policy taken by transit agency managers, local policymakers, and other interested actors in each metropolitan area, and our sense of the results of these approaches. The authors direct the reader's attention to these case studies for the detailed stories and numerous lessons they contain.

WHAT WE DO KNOW ABOUT THE FACTORS ASSOCIATED WITH (RAIL) TRANSIT SUCCESS OR FAILURE

Our research focus is to evaluate the influence of service planning decisions on rail transit success or failure. In particular, we are interested in how rail service planning decisions influence metropolitan transit ridership. In conducting this examination, we need to take into account an array of other factors that may also influence transit ridership. To identify these factors and consider their likely effects on ridership, we consulted an extensive literature. (We include an annotated bibliography of sources cited in this section as Appendix M.)

The literature, which largely consists of works that examine transit ridership in general, as opposed to rail transit in particular, classifies these factors into two general categories. The first category consists of factors that are outside the control of transit agency managers and hence are called external factors. These include: the urban structure of a metropolitan area, land use patterns around bus or rail stations, levels of automobile ownership in the community, automobile costs (including fuel and parking prices), regional economic health, personal and household incomes, and the race, ethnicity, and immigrant profiles of the metropolitan area. All these factors have been linked (either positively or negatively) to the level of transit usage by area residents.

The second category consists of factors that are at least partially under the control of transit agency managers and hence are called internal factors. These include: fare structures and policies, service coverage, service frequency, service orientation, amenities, and special services targeted to specific groups of users. All these factors have been linked (either positively or negatively) to the level of transit usage by area residents.

In this chapter, we briefly review the literature on factors that affect transit ridership. First, we present literature that examines transit ridership in general. We then present literature that considers rail transit ridership in particular. Both types of literature are relevant to our case study, because both identify factors whose influence we need to account for in conducting our examination of the influence of service planning decisions on rail transit ridership. We close the chapter with a brief summary of key insights from the literature.

LITERATURE ON TRANSIT RIDERSHIP IN GENERAL

The literature review discussion proceeds as follows: 1) works that provide a descriptive overview of transit ridership; 2) works that emphasize external factors that affect ridership; and 3) works that emphasize internal factors that affect ridership.

Descriptive Overview of Transit Ridership

In the postwar period, transit ridership experienced a long decline followed by a number of recent peaks and valleys. Jones and Vuchic provide general discussion of the longer-term trend, emphasizing the decentralization of urban areas and competition with the automobile as among the primary causes for transit's postwar decline.[4] By the 1970s and 1980s, Jones observed that transit was largely limited to serving two markets: transit-dependent individuals and commuters traveling to and from jobs in the central business districts in the nation's largest cities.[5]

Transit-dependent individuals are defined as individuals who for reasons of age, income, or disability, lack either access to or the ability to use an automobile and thus rely on public transit as a primary means of transportation. Researchers have typically measured transit dependency using variables such as household income, age, race, ethnicity, immigrant status, and number of automobiles in the household. National transportation surveys (such as those conducted in 1983, 1990, 1995, and 2001) regularly report that individuals who fall into certain demographic group categories (defined using these variables) are disproportionately transit users. Using data from the 2001 National Household Travel Survey, Pucher and Renne found that the poor, blacks, Hispanics, and those with low levels of vehicle ownership are more likely to use transit than are other groups. Particularly important is the latter variable.[6] The same survey found, however, that the numbers of individuals placed into the demographic categories we use to define transit dependency declined between the 1995 and 2001 surveys. The surveys also reported that even for transit dependent groups, transit is not their primary mode of transportation—the automobile is.

During the mid and late 1990s, a series of articles appeared documenting a large decline in transit ridership during the early part of the decade and speculated that public transit was headed for rough times. However, in the late 1990s and on to the present, ridership (measured in terms of unlinked passenger trips, but not mode share) increased. Pucher identified the economic recession of the early 1990s, and particularly its effect on employment in New York, as the driving force behind the ridership decline of the early 1990s.[7] He cites the economic recovery of the 1990s, rising gasoline prices, stable fares, improved service quality, and the expansion of rail transit services as among the key contributing factors for the ridership rebound of the latter part of the decade. The limitation of this article is that it is purely descriptive; Pucher makes no effort to examine other potential causes using more sophisticated multivariate techniques.

Thompson and his coauthors examine the ridership trend in the nation's largest cities. Focusing on the period between 1990 and 2000 in all metropolitan statistical areas that had more than 500,000 persons, they paint a picture of ridership that grew faster than population growth in areas that most researchers would not suspect, namely in the metropolitan areas of the auto-oriented west.[8] They note that service grew in most parts of the country as well. They also find that service productivity (measured in terms of load factor, or the ratio of passenger miles to vehicle miles) declined throughout the country, but experienced the smallest decline in the West. In short, western cities added a lot of service and gained a lot of riders in doing so. However, this purely descriptive piece does not explain why transit is growing in many "surprising" places.

The External Factors that Influence Transit Ridership

The external factors that influence transit ridership include: urban structure (decentralization), local land use patterns, automobile ownership levels and costs, and regional economic conditions.

Urban Structure (Decentralization)

Meyer, Kain and Wohl, Jones, and Vuchic cite urban decentralization as one of the primary causes of the long-term decline in transit use in the postwar period.[9] The corollary is that transit use is positively tied to the degree of urban centralization, and in particular, the strength of the central business district (CBD) as a locus of economic activity. Mierzejewski and Ball found some support for this notion, where choice riders (those who have access to an automobile but choose to use transit) are concerned.[10] In a survey of 4,000 persons in 17 metropolitan areas, they found that 82% of choice riders who used transit worked in the central city.

The conventional wisdom is that transit works best when it focuses on serving the CBD commute market.[11] The implication is that transit agencies should structure their service to feed the CBD and provide high quality service to that destination, because that, the literature would suggest, is where riders wish to travel. An agency decision to serve other destinations, particularly those dispersed throughout the suburbs, is criticized for being an inefficient use of public subsidy[12] and for resulting in low service productivity.[13]

There have been a handful of studies that have examined the link between urban structure and transit ridership using statistical techniques. Some studies have found a close link between decentralization and transit ridership while others have found a more complicated set of relationships between these variables. Most studies have used the relative strength of the central business district as the measure of urban structure.

Henderson examined the relationship between transit commute mode share and the number of jobs in the central business district in 1970 and 1980 for 25 large metropolitan areas using a series of multivariate models.[14] The first multivariate model estimated ridership in 1970 as a function of CBD employment in 1970 (R square = .96), the second model estimated ridership in 1980 as a function of CBD employment in 1980 (R square = .90), and the third model estimated ridership in 1970 as a function of both CBD employment and the total number of workers in the metropolitan area (R square = .98). He then estimated two change models, one with a dummy variable for Sunbelt cities (R square =.77) and one without (R square = .66). Finally, he estimated a change model with dummy variables for both Sunbelt cities and those with fixed rail systems (R square = .81).

Hendrickson found strong relationships between CBD employment and transit commute mode share.[15] He found positive, statistically significant effects on transit commute mode share from the Sunbelt dummy variable, and negative, statistically significant effects from the fixed-rail dummy variable. However, his study suffers from two shortcomings, which include: 1) lack of control variables and 2) mixing of cities with significant differences in both the size of the CBD and the transit commute mode share. Particularly problematic is the inclusion of New York, which dwarfs the other cities on both variables, in the same analysis.

Gomez-Ibanez conducted a more sophisticated analysis of the relationship between transit ridership and decentralization in Boston.[16] He used a time series approach that examined ridership between 1970 and 1990, and included variables that controlled for fare, per capita income, and service level. His measure of decentralization was the number of jobs in the city of Boston. He found: 1) a 1% decline in the percent of jobs in the city of Boston was associated with between a 1.24% and 1.75% decline in ridership; 2) a 1% increase in real per-capita incomes was associated with a 0.71% decline in ridership; 3) a 1% increase in fares was associated with a .22% to .23% decline in ridership; and 4) a 1% increase in vehicle miles of service was associated with a .30 to .36% increase in ridership. His models accounted for nearly 90% of the variation in transit ridership from 1970–1990.

Gomez-Ibanez concluded that transit ridership in Boston has been strongly influenced by the decentralization of employment. However, the definition of employment is problematic and measures jobs throughout the city of Boston as opposed to jobs inside the central business districts of Boston and Cambridge, which the author states he had hoped to measure.

Two recent statistical studies have found very different results. Brown and Neog examined the relationship between transit ridership and urban structure in all U.S. metropolitan statistical areas with more than 500,000 persons in 1990 and 2000.[17] They define urban structure as the percent of metropolitan statistical area (MSA) employment in the CBD and use two measures of transit ridership, passenger kilometers per capita and transit commute mode share. The authors controlled for variables measuring fare, service frequency, service coverage, motor fuel price, urban area population density, regional unemployment rate, and the percent of households in each metropolitan area that lacked access to an automobile. They found no statistically significant links between the percent of MSA employment in the CBD and transit ridership. The authors found the strongest links between two service variables (service frequency and service coverage) and transit ridership. They also found a strong relationship between the percent of MSA households that do not own an automobile and transit ridership.

Brown and Thompson examined the relationship between transit ridership and urban decentralization in Atlanta from 1978 to 2003.[18] The authors used linked passenger trips as their ridership variable. They created three employment variables to measure the degree of employment decentralization: percent of employment in the CBD, percent of employment outside the CBD but inside the transit service area, and percent of employment outside the transit service area. They controlled for fare, service level, motor fuel price, and population decentralization in their time-series analysis. They also included a variable measuring the percent of transit service delivered by rail transit.

They found that transit ridership is strongly and positively linked to the strength of employment inside the transit agency service area (outside the CBD) and is strongly and negatively linked to the strength of employment beyond the transit agency service area. The authors found no association between the strength of the CBD and transit ridership in Atlanta. The authors also noted that transit ridership is more strongly linked to the decentralization of employment than to the decentralization of population, and that fare levels and the absolute amount of transit service are also associated with transit ridership. The authors infer that the Metropolitan Atlanta Rapid Transit Authority (MARTA) is successfully connecting transit patrons to dispersed employment locations.

Local Land Use Patterns (Transit-Oriented Development)

Over the past two decades, there has been a great deal of interest in the relationship between local land use patterns near bus and rail transit lines, stops, and stations and transit ridership. Often lumped under the label of transit-oriented development (TOD), this body of literature hypothesizes that the density, land use mix, and urban design characteristics of a neighborhood can influence individual mode choice decisions.[19] There is an extensive literature on the subject, much of which builds on work by Robert Cervero.

The primary hypotheses about transit-oriented development and its relationship to ridership are voiced in books by the team of Bernick and Cervero, and Cervero on his own.[20] Both books rely on case study analysis to argue that developments characterized by higher density, more mixed uses, and more pedestrian-friendly designs tend to have higher transit ridership. Therefore, the suggestion is made that if metropolitan areas promote these kinds of developments they should expect to see auto use decline, while transit use, walking, and perhaps bicycling increase in importance. Indeed, Parker and co-authors found associations between transit-oriented development and transit mode share in their case study of transit-oriented development in California.[21]

Lund and Willson, on the other hand, found weak ridership results in their case study of transit-oriented development along the gold line light rail line in suburban Los Angeles.[22] They surveyed the residents in 37 multi-family buildings located within 1/3 mile of rail stations. Of 1,595 housing units surveyed, they obtained responses from 221 units recording information about 477 trips. They found few transit-dependent residents in their survey. Respondents were primarily white, worked in professional occupations, and owned one or more automobiles. Few residents had low incomes. About 75% of respondents rarely or never used transit, while 15% regularly used transit. Lund and Wilson noted that respondents were more frequent transit users after they moved to their current place of residence, but noted that there might be a self-selection bias at work. Essentially, they found that TOD in this particular corridor was too expensive to be occupied by transit riders and was instead occupied by wealthier professionals, who tend not be transit riders. The mismatch between TOD residential profiles and transit user profiles is frequently noted by TOD skeptics. Residential self-selection has also been cited by TOD skeptics who assert that the people who live in residential TODs are people who were already predisposed to engage in more use of non-automobile transport modes.

There are, however, a number of quantitative studies that have found a connection between TOD-associated elements and ridership. These studies have examined the relationship between transit ridership and distance, density, diversity, and design. Cervero discussed several studies that examine the ridership characteristics of projects located near rail transit stations.[23] He cites a 1989 San Francisco Bay Area study found that 35 to 40% of residents living near three Bay Area Rapid Transit District (BART) stations used public transit. He also cited a 1987 Washington DC study that found that rail and bus transit mode share declines by 0.65% for every 100-foot increase in distance of a residential site from a rail transit station. The same 1987 study found that ridership was higher at downtown than at suburban work sites and that ridership declined steadily as distance to the station increased. All these studies essentially examined the correlation between transit mode share and distance to a rail station. They did not control for other factors that might influence an individual's decision to use public transit (fare, service quality, auto access and cost, or the ease with which travelers could reach their destinations).

The Institute of Urban and Regional Development reported the descriptive results of residential studies showing that: 1) workers living near the San Francisco area's Bay Area Rapid Transit District (BART) heavy rail line were six times more likely to use it for commute trips than the average Bay Area resident; 2) workers living near light rail transit in Silicon Valley were five times more likely to use transit for commute trips than average area residents; and 3) people living near transit in Washington DC have high transit mode shares that decline with increased distance from a transit station.[24] The authors also summarized a set of office and retail studies that showed: 1) 50% of those working within 1,000 feet of a downtown Washington Metro station used rail to get to work; 2) 60% of customers at a downtown San Diego shopping center located two blocks from light rail arrived either by transit or by foot; and 3) 34% of patrons at a downtown San Francisco shopping center that has a direct connection to BART arrived by transit.

More studies have focused on the link between density and transit ridership than any other factor. These studies have their roots in early work by Pushkarev and Zupan.[25] Parsons Brinckerhoff found, in a study of 17 cities with light rail or commuter rail, that residential densities had a strong effect on transit boardings.[26] Spillar and Rutherford also documented a density effect in their analysis of Denver, Portland, Salt Lake City, San Diego, and Seattle.[27] They noted, however, that density appeared to have a stronger relationship with transit ridership in low-income neighborhoods. The Institute of Urban and Regional Development also presented a set of multivariate models from studies for the San Francisco Bay Area and Arlington County, Virginia that indicate particularly strong relationships between the density of the land use and transit ridership.[28] Overall, the authors concluded that residents living in

TODs usually patronize transit five to six times as often as the typical resident of a region. The authors acknowledged that self-selection bias might be an issue in the residential studies they discuss. Cervero found a modest density effect on ridership (elasticity between 0.2 and 0.6) in his study of Montgomery County, Maryland.[29]

Kuzmyak and his coauthors also reported that transit ridership tends to be higher at higher densities.[30] Citing work by Parsons Brinckerhoff for the city of Chicago, they reported that a 10% increase in residential density is correlated with an 11% increase in per-capita transit trips and a 13% increase in transit mode share. Citing work by Levinson and Kumar for a national study of the U.S., they reported that density only becomes relevant to mode choice at densities higher than 7,500 persons per square mile. Citing work by Frank and Pivo in Seattle, they also noted that transit requires workplace densities of 50–75 employees per gross acre and residential densities of 10–15 dwelling unit per net residential acre to achieve significant commute mode shifts. Citing a study by Nelson/Nygaard for Portland, Oregon, they noted that housing density and employment density accounted for 93% of the variation in daily transit trip productions and attractions across the region. The authors cautioned that in many of these studies, self-selection bias may be a concern.

Kuzmyak and his coauthors also presented the results of studies indicating that transit use tends to be higher in areas characterized by mixed land uses.[31] However, they cautioned that many of these environments tend to also be characterized by higher densities, so separating the mixed-use effect from the density effect is difficult. Citing work by Messenger and Ewing in Florida, they noted that more balanced (jobs and workers) areas tend to have higher transit mode share. Citing a study by Cervero of 57 suburban activity centers, the authors noted that centers with on-site housing had 3 to 5% more transit, bike, and walk trips.

Transit-oriented development is also characterized by more transit and pedestrian-friendly urban design. Urban design is the hardest of the 3 Ds (density, diversity, design) to measure, but there have been a few studies on the effect of urban design on transit ridership. Cervero found that urban design, and particularly sidewalk provisions and street dimensions, significantly influence whether someone reaches a rail stop by foot or not in his study in Montgomery County, Maryland.[32] He asserted that conversion of park-and-ride lots to transit-oriented developments holds considerable promise for promoting walk-and-ride transit usage in years to come. Cervero found a relationship between street connectivity and an individual's decision to use transit in his study of people living near rail stations in California.[33]

Other External Factors

The literature has also identified a number of other factors beyond the control of agency managers that can influence transit ridership. These factors include population and population growth,[34] regional economic conditions,[35]housing costs,[36] and personal income.[37]

Some particularly important additional external factors relate to the automobile. Studies by Brown and Neog, Liu, and Taylor and Miller have all highlighted the important relationship between the share of carless households in a metropolitan area and transit ridership.[38] Studies by Dueker and his coauthors and Mierzejewski and Ball have noted the important role played by parking availability and cost in influencing transit use.[39]

The Internal Factors that Influence Transit Ridership

The internal (agency-controlled) factors that influence transit ridership include: fare policy, service frequency, service coverage, service orientation, and targeted marketing efforts.

General Discussion

There is a sizeable descriptive literature that introduces service strategies that might influence transit ridership in particular settings—without evaluating the performance of the particular strategy. One author who has conducted significant past research in this area is Robert Cervero. Cervero identified timed transfer systems, paratransit services, reverse commute and specialized runs, employer-sponsored van pools, and high-occupancy-vehicle and dedicated busway facilities as transit service strategies that might result in higher ridership in decentralized areas.[40] He reemphasized these kinds of service strategies in his international case study of transit metropolises.Working with Beutler he discussed the use of bus rapid transit services and free market paratransit services as possible service strategies in certain urban environments.[41]

Using case studies of eight transit agencies in the United States and Canada, Charles River Associates identify feeder bus, fare integration, Express bus, times transfer, pass programs with universities, and a fareless square as promising strategies in certain environments.[42] However, these same authors conclude that policies that make private vehicle use less attractive will have a larger positive effect on ridership than policies that make transit more attractive.

A number of authors emphasize the role of targeted marketing and market segmentation as strategies to increase ridership among specific rider groups.[43] Cambridge Systematics uses repeated surveys of agencies that experienced ridership increases to identify fare policies, service adjustments, and marketing efforts as key factors that affect transit ridership.[44] Miller and his coauthors champion the use of service integration, including infrastructure, fare payment, and/or special events/emergency service integration, as positive service strategies.[45] Haas discusses the use of Eco pass programs, guaranteed ride home programs, day passes, and online fare media sales programs.[46] Rosenbloom and Fielding identify targeted use of reverse commute services, services to large employers (including universities), vanpool incentives, route restructuring, and feeder services as key service strategies.[47]

Skinner found, however, that transit services targeted toward particular ridership markets might have unexpected negative effects.[48] Miami-Dade Transit operates a number of routes that seek to serve the elderly population, and connect social service and other destinations to residential areas where the elderly reside. However, these routes have low elderly and non-elderly ridership, and as a result, very poor performance, because they are slow and indirect.

Project for Public Spaces discusses the role of amenities, including the use of low-floor buses in Ann Arbor, commuter buses in Aspen, transit shelters in Portland, and Rochester, and historic streetcars in San Francisco.[49] The report includes some data on cost and ridership for each of the case studies. There is no discussion of other factors that might explain the ridership increases documented for the case studies nor is data collected that would enable a reader to do so.

Finally, the California Department of Transportation uses a survey of actual and potential riders to identify service reliability, convenience, comfort, and safety as key factors that might influence an individual's decision to ride transit. [50]As noted above, none of these articles evaluates the performance of the strategy or factor that the authors describe.

Fare Policy

There is an extensive body of literature that documents the relationship between fare levels and ridership.[51] Kyte found an important relationship between fare and ridership in his study of Portland.[52] Taylor and his coauthors documented the importance of fare policy in their U.S. national study,[53] and so did Kohn in his Canadian study.[54] Kain and Liu noted the importance of fares in their study of Houston and San Diego,[55] as did McLeod, et al. in their time-series analysis of Honolulu.[56]

TRL Limited summarizes the results of an extensive set of empirical studies.[57] They report that fare elasticities vary depending on both mode and timeframe. Bus fare elasticities average around -0.4 in the short run, -0.56 in the medium run, and -1.0 in the long run. Rail transit elasticities tend to be higher than those for bus for suburban rail services and smaller than those for bus for heavy rail. Off-peak ridership tends to be twice as responsive to fare changes as peak period ridership.

McCollom and Pratt provide a similar review of empirical work.[58] For bus transit, the authors report elasticities at around -0.4 and for rail transit they report elasticities at around -0.18. They found that riders are more sensitive to off-peak fares than to peak period fares, and that elasticities decrease as the size of the city increases.

Service Frequency and Coverage

There is also a large group of literature that documents the relationship between the service provided by an agency and transit ridership.[59] A smaller number of literature has broken down service into two components: frequency and coverage. Both are hypothesized to positively influence ridership. Brown and Neog, and Thompson and Brown[60] found positive effects of both service frequency and service coverage in their national analyses of transit ridership in large U.S. metropolitan areas in 1990 and 2000. Brown and Neog report elasticities for both service and coverage in the 0.7 to 1.0 range.[61]

Evans provides an overview of empirical work on the relationship between transit service frequency and ridership.[62] He found that ridership does respond to service frequency and schedule changes (elasticity = 0.5), and that the largest responses are found in higher income areas that previously had very infrequent service. In more traditional transit areas, the ridership response was more modest.

Pratt and Evans examined the relationship between coverage and ridership in a routing study.[63] The authors found elasticities in the range of 0.6 to 1.0. The authors noted that the largest ridership increases occurred when the system emphasized "high service level core routes, consistency in scheduling, enhancement of direct travel and ease of transferring."[64] The authors claim that new and expanded systems of the hub-and-spoke variety produced slightly higher ridership than grid systems, although there were no controls for other possible variables.[65] Taylor, et al. also noted that route coverage was an import influence on transit ridership.[66]

Service Orientation

A particular interest in this project is the role of service orientation as a factor influencing transit ridership. Regrettably, there have been few studies that explicitly examine service orientation. Thompson and Matoff conducted an early case study analysis of nine cities in which they distinguished between radial and multidestination (grid) oriented transit systems.[67] The authors obtained data on transit system profiles and transit performance from 1983 to 1998 for transit systems in Cleveland, Columbus, Houston, Minneapolis, Pittsburgh, Portland, Sacramento, San Diego, and Seattle. The performance measures include: cost per passenger mile, peak-to-base ratio, passenger miles per capita, and vehicle miles per capita. The authors then compared systems that met their definitions of multidestination versus radial service orientations on each of these measures. The authors found that multidestination systems were more effective (that is, had higher ridership), nearly as efficient (about the same cost), and more equitable (lower peak-to-base ratio) than radial systems.

More recently, Thompson and Brown explored the relationship between service orientation and ridership using a statistical analysis.[68] The same authors have also recently explored the relationship between service orientation and service productivity.[69] In their ridership study, identify and examine the key determinants of transit ridership change between 1990 and 2000 in U.S. MSAs with more than 500,000 persons. Among the key variables they examine is a service orientation that distinguishes between multidestination and traditional service orientations. The authors found that transit is growing most rapidly in the non-traditional markets of the West but that much of the regional variation is a function of the particular service coverage, frequency, and orientation decisions made by transit agencies in this region. Service coverage and frequency are the most powerful explanatory variables for variation in ridership change among MSAs with 1 million to 5 million people, while a multidestination service orientation is the most important explanation for variation in ridership change among MSAs with 500,000 to 1 million people. A weakness of the analysis is the definition of the service orientation variable as a binary variable, as opposed to a continuous one.

Their productivity paper substitutes a quantitative variable that measures the percent of transit routes that do not serve the CBD.[70]They find that decentralized service orientation does not lead to diminished productivity. In fact, the signs on the coefficient for this variable in their statistical models are positive, although not statistically significant.

LITERATURE ON RAIL TRANSIT RIDERSHIP IN PARTICULAR

The literature review discussion proceeds as follows: 1) works that provide a descriptive overview of rail ridership; 2) works that emphasize external factors that affect rail ridership; and 3) works that emphasize internal factors that affect rail ridership. Many of the sources discussed in the section on transit ridership in general also have important insights to provide to rail transit, but the works discussed in the next few pages are focused solely on rail transit.

Descriptive Overview of Rail Ridership

Rail transit investments have been both applauded, particularly by advocates of transit-oriented development, and criticized, particularly by economists. On the pro-rail side, advocates like Litman have argued that cities with large, well established rail systems have significantly higher per capita transit ridership, lower average per capita vehicle ownership and annual mileage, less traffic congestion, lower traffic death rates, lower consumer expenditures on transportation, and higher transit service cost recovery than otherwise comparable cities with less or no rail transit service.[71] Litman suggests this indicates that rail transit systems provide economic, social and environmental benefits, and he insists that these benefits tend to increase as a system expands and matures.

Polzin and Page found increasing transit ridership for 24 light rail transit systems constructed between 1980 and 2001.[72] The authors found that ridership trends for the rail projects, in the authors' words, "matured quickly." Ridership increases tended to be substantial in the immediate aftermath of system opening and then became relatively stable. They attribute subsequent growth in ridership to changes in system extent and service frequently. Despite the positive effects of the light rail transit (LRT) lines on overall transit ridership, the authors note that transit continues to play a modest role in overall metropolitan travel. Nevertheless, the authors believe the LRT investments may be important in stimulating community attention and further investment in transit in the metropolitan area. One caution in their work is the use of unlinked passenger trips as their ridership measure. Unlinked passenger trips are influenced by the number of transfers, which tend to be higher in systems with rail transit.

There are, however, rail transit critics who have singled out the high costs and/or low ridership results of many rail projects. O'Toole paints portraits of a series of great rail transit disasters.[73] Clearly no fan of rail transit, he found that transit ridership is falling in 13 of the 23 metropolitan areas that implemented rail between 1982 and 2003, is increasing slower after rail construction than before it in four metropolitan areas, is increasing but slower than the growth in vehicle travel in three metropolitan areas, is growing just as fast as auto use in one metropolitan area, and is growing faster than auto use in two metropolitan areas (Boston and

San Diego). The author then examined four metropolitan areas that have bus-only transit where transit ridership is growing faster than auto use (Austin, Charlotte, Las Vegas, Louisville, and Raleigh-Durham), as cases of transit success. O'Toole's central argument is that metropolitan areas that have invested in rail transit have wasted their citizens' money. He contends that the investment has often resulted in less transit ridership because agencies have frequently responded to rail cost overruns by raising fares and/or cutting bus service.

Moore made similar complaints about the Blue Line light rail transit line in Los Angeles, although ridership on the line today is very strong.[74] Richmond echoes these arguments while also criticizing the motivations of planners and public officials who have made the choice to invest in rail transit.[75]

Pickrell has criticized rail transit planners for their roles in these disputes.[76] He compared the forecast and actual ridership and forecast and actual capital costs for eight rail transit projects (four light rail and four heavy rail) in eight cities (Atlanta, Baltimore, Buffalo, Miami, Portland, Sacramento, Washington) in an attempt to verify the accuracy of the forecasts and, when forecasts were inaccurate, to identify the reasons for the inaccuracies. He found that planners consistently overestimated ridership and underestimated costs for these rail projects. He also determined that the errors are not associated with flawed assumptions about key variables like population and downtown employment (which turned out be fairly accurate) nor are they the result of changes in the design of the projects. Instead, he attributes these overoptimistic forecasts to the structure of the federal transit grant programs.

Several authors have developed single or comparative case studies of transit ridership in cities with rail transit systems. Tennyson's discussion of postwar transit ridership trends in Saint Louis emphasizes the role of rail transit in positively affecting overall agency performance.[77] He notes that light rail service began as part of an effort to restore the viability of transit service in the metropolitan area. He points out that the results were "immediate and positive;"[78] transit ridership increased 40% and the cost of providing service stabilized after a period of continued increases.

Allen and Hufstedler provide a comparative case study of Dallas (a bus-and-rail city) with Houston (at the time a bus-only city) between 1985 and 2003.[79] The authors found that both systems experienced increased ridership over the period. The two systems have experienced similar ridership peaks and valleys. The authors report that Dallas's light rail system expansion resulted in overall transit ridership increases, despite some decline in bus transit ridership. Houston's heavy commitment to its all-bus system has resulted in both higher service and ridership levels than Dallas Area Rapid Transit (DART), although the two systems have comparable populations. In general, the authors conclude that light rail transit in Dallas has had a positive effect on transit ridership. The paper is purely descriptive and does not attempt to identify causes for the findings.

Schumann[80] provides a comparison of Columbus and Sacramento[80] in 1985 and 2002.These two state capitals pursued different transit paths during this period; Columbus remained an all-bus system, while Sacramento opened a light rail transit system. In 1985, the transit system in Columbus (Central Ohio Transit Authority, or COTA) outperformed the system in Sacramento Regional Transit (RT), but by 2002, the roles had reversed. In the intervening period, Sacramento had successfully opened a light rail transit system and then restructured its bus system to provide riders with the ability to reach a wider array of destinations. Columbus failed to build light rail and instead retained an all-bus system. The author notes that different levels of local financial support explain both Sacramento's ability to develop light rail and Columbus's failure to do so.[81]

Schumann states that "in Sacramento, willing political leadership took advantage of a one-time opportunity for federal funding to build an LRT starter line, that adding LRT made transit more visible and effective, encouraging voter approval of additional local operating and capital funding, and that all of this resulted in a synergy that attracted more riders to the total LRT and bus system, and led to extension of the rail system to a third corridor in 2003. Although planning for light rail transit also started in Columbus during these same years, a serious interruption in the flow of local funds hampered transit development, requiring cuts in bus service and preventing development of that region's LRT line which, had it been built, could have enhanced transit's attractiveness."[82]

Statistical Studies of External Influences on Rail Ridership

There have been a few statistical studies that have examined rail transit performance by focusing almost entirely on the external factors that influence rail ridership. Baum-Snow and Kahn evaluate whether rail transit improvements made between 1970 and 2000 in sixteen metropolitan areas led to new transit ridership.[83] They define transit ridership using the journey-to-work mode shares. The authors estimate multivariate models (for each of sixteen metropolitan areas) that predict transit mode share (at the census tract level) as a function of distance to the central business district (CBD) and distance to the nearest rail line. The authors do not control for any other socioeconomic factors.

Baum-Snow and Kahn found decreasing marginal returns of new rail investments for all cities but Portland and Atlanta.[84] Interestingly, they note that a network effects argument, wherein later infrastructure connects riders to a broader array of possible destinations, might explain these two exceptions. The authors also find large potential commute time savings associated with the rail investments but observe little to no effect on pollution and congestion externalities.

Chung examined the effects of employment, CBD office occupancy rates, and parking on rail transit ridership in Chicago when controlling for fare.[85] He found all three variables to be statistically significant. The ordinary least squares regression model had an R-squared of 0.90, indicating that variation in these explanatory variables accounted for 90% of the variability in rail transit ridership over the 1976 to 1995 study period.

Statistical Studies of Internal Influences on Rail Ridership

There have also been a few studies that have considered both external and internal factors that influence either actual or potential rail transit ridership. Abundo examined commuter rail ridership in Boston from 1980 to 1997.[86] She found that approximately 80% of the recent ridership growth was due to fare policies and service improvements and 20% was due to factors outside the agency's control.

Two statistical studies examine the role of service orientation (and in particular market focus) in the rail transit context. Hadj-Chikh and Thompson examined traffic patterns on the Tri-Rail commuter rail system in south Florida.[87] The station siting process led to the construction of some stations that seemed well-suited to serving suburban transit markets as opposed to the central business district-bound market. The authors compare the degree to which people are using the service to reach suburban destinations versus the central business district. They gathered ridership data from Tri-Rail staff. These data provided information on ridership between all pairs of stations (from automated ticket machines) for one work week during a twelve-hour period (4 a.m. to 4 p.m.). They then classified station pairs as serving the suburb-to-suburb or suburb-to-CBD market. They made comparisons between the two markets for six distance categories.

The authors find that both markets have comparable total potential ridership. They identify potential ridership all along the Tri-Rail corridor, not just where the CBD is the destination. They also found that Tri-Rail penetrates the suburb-to-CBD market about twice as much as the average suburb-to-suburb market. The authors also noted that market penetration increased with distance, although the model left a considerable amount of unexplained variation in the dependent variable.

The authors use the results to highlight the existence of sizeable suburb-to-suburb demand for commuter rail service. They observe that commuter rail planners who are developing their systems to serve CBD markets might be able to tap this potential market at very little additional cost.[88]

Whately, Friel, and Thompson conducted a similar analysis in Southern California and found that the ridership potential for the average suburb-to-suburb station pair is three times greater than for suburb-to-CBD.[89] They observed that most of the suburb-to-suburb potential is found in the shorter trip distance categories (under 20 miles), that the market potentials are about even for trips between 21 and 30 miles, and that the market potential for suburb-to-CBD is greater in the 31-plus mile trip distance category. In addition, they found that market penetration is negligible for suburb-to-suburb trips in the shorter distance categories but larger in the longer distance categories. In general, as distance increases, so does market penetration. They conclude by emphasizing the significant market potential for suburb-to-suburb trips. Whaley et al. suggest that more frequent service and fare structures oriented to short distance riders might be strategies to tap these markets. They also note that rail lines should continue to serve traditional CBDs and attempt to serve nearby suburban employment clusters as well.

LESSONS FROM THE LITERATURE

The literature review suggests that an array of factors, both outside and under the control of transit managers, is associated with (rail) transit success. The literature indicates that the key factors outside the control of transit managers (external factors) are urban structure, local land use patterns, population and population growth, regional economic conditions, and last, but certainly not least, automobile-related variables, including levels of automobile ownership, parking availability and cost, and motor fuel price. The most consistently strong external factors are urban structure and the automobile ownership and price variables. The relationship between urban structure (decentralization) and ridership appears to be a particularly complex one, given recent insights by Brown and Thompson, and Brown and Neog.[90] Past studies have indicated a close relationship between the strength of the CBD as a locus of economic activity and transit ridership, but these recent studies indicate that CBD employment is not as important as non-CBD employment that is accessible by transit. This insight has obvious relevance for the way transit agencies structure their route systems. The automobile variables are also among the key determinants of transit ridership. The literature shows that an individual's decision to ride or not ride transit is strongly influenced by whether or not the individual has access to an automobile. The literature review suggests that our examination should attempt to control for the influence of these key external factors on the level of transit ridership in the metropolitan areas we study.

The literature review illustrates that the key factors under the control of transit managers are fare policy and service planning decisions, including service coverage, service frequency, and service orientation.[91] The literature suggests that all these factors are important influences on the level of transit ridership, with service frequency and coverage cited as being more influential than fare policy. The time individuals spend waiting for a vehicle is often cited as being viewed as particularly onerous by riders and better service frequency means riders do not have to wait long for the next bus or rail vehicle. Better service coverage provides individuals with access to more origins and destinations, thus making transit a viable travel option for a wider array of trips. Combined, better frequency and coverage enhance transit's relative attractiveness vis-à-vis the automobile.

Service orientation also appears to be quite important. The few studies that have investigated the influence of service orientation on actual (or potential) ridership or service productivity have found that networks that offer travelers access to a dispersed array of destinations perform better than networks oriented to serving CBD-bound commuters.[92] Our examination focuses on the role of service planning decisions in determining transit success or failure, and hence this literature citing the importance of service coverage, frequency, and, especially, orientation offers particularly important insights to our investigation.

A critical gap in this service-focused literature, which we hope to fill with this study, is the interrelationship between bus and rail service. The articles by Allen and Hufstedler, and Brown and Thompson offer anecdotal evidence indicating the importance of this interrelationship for increased transit ridership in Atlanta and Dallas, but it has yet to be examined in any meaningful way—either statistically or through qualitative case studies.[93] This study offers the first attempt to examine this relationship, which we believe explains why some cities succeed and others fail in their efforts to leverage rail transit investment to increase transit ridership.

RESEARCH METHODOLOGY

This investigation of the influence of planning decisions on rail transit success or failure required the use of a combination of qualitative and quantitative methods. The authors began their investigation by developing a timeline of transit planning and system development in each of our eleven study areas. They constructed these timelines by examining planning documents, newspaper and journal articles, and secondary literature in each study area. At the same time, they queried the National Transit Database (NTD) to develop descriptive statistics on transit ridership, service, and service productivity for each transit agency in our eleven study areas. The authors then examined those statistics to identify ridership, service, and performance trends, which we then related to events contained in each of our study area timelines.

These initial quantitative and qualitative investigations informed the development of an interview guide for their telephone interviews with key informants in each of the study areas. The authors obtained a list of key informants largely by querying contacts developed in earlier research and through professional relationships. Since 2002, Thompson had been interviewing participants in the development of the light rail transit movement in North America. Interviewees included those who planned the first national light rail conference, jointly sponsored by the Transportation Research Board, the Urban Mass Transit Administration, and the American Public Transit Association and held in Philadelphia in June 1975. Interviewees also included those involved in decision-making that led to the decision to build light rail transit lines in Edmonton, Calgary, San Diego, Portland, Sacramento, and San José. By the time this research began he had transcripts of 47 interviews. Many interviewees helped develop the list of key informants for this study. Thompson also chairs the research committee for the Light Rail Transit Committee of the Transportation Research Board, and that position led to the identification of additional key informants.

The authors asked study informants about the development of the transit system, its purpose, and its performance. They also asked these informants to provide us with the names of contacts inside the metropolitan planning organization (MPO) and/or transit agency from whom they could obtain detailed population and employment data, transit service and ridership data, on-board passenger survey data about rider demographics and transfer activity, and other statistical information that allowed them to develop a detailed portrait of the functions and performance of specific types of transit services and their relationship to the changing urban structure of each of the study areas.

The analysis of these data served as the fourth phase of the project. The combination of these analyses allowed the authors to develop the planning and policy recommendations contained in the body of the report, as well as the more detailed individual case studies contained in the appendices. Each phase of the research project is discussed in more detail below.

DEVELOPMENT OF TRANSIT PLANNING AND SYSTEM DEVELOPMENT TIMELINES

The first phase of the research project involved the development of timelines of transit planning and system development in each of the study areas. The authors began with information obtained by the authors in earlier inquiries of transit planning history in Atlanta, Dallas, Portland, Sacramento, and San Diego.[95] They filled in missing information for these cities, and developed timelines for other cities, using a combination of: 1) planning documents prepared by transit agencies, metropolitan planning organizations, consulting firms and other documents; 2) newspaper accounts in the major newspapers in each study area; 3) contemporary and historical accounts of events in each study area found in scholarly and non-scholarly periodicals; 4) unpublished papers prepared for scholarly conferences such as the Annual Meeting of the Transportation Research Board (TRB); and 5) secondary source materials, including histories of urban politics, public transit, and the intersection between public policy decisions and race relations from both a national perspective and in a few of our study areas. Because the sources consulted in the development of these timelines are too many to cite here, the authors instead cite the timelines as the sources for information gathered in this phase of the project.

The purpose of the historical investigation was to get a sense of the transit planning history in each of the study areas. Particularly important to the authors was gaining understandings of: 1) the changing nature of the regional vision for transit in each study area; 2) the evolution of rail, bus, and other transit mode transit system plans; and 3) the roles played by different interest groups in each stage of transit system development. These understandings helped the authors to frame the questions we posed in the interview phase of the project.

Descriptive Examination of Metropolitan Transit Performance

The second phase of the research project involved the development of a descriptive portrait of transit performance in each study area. To develop this portrait, the authors queried the National Transit Database using the Florida Transit Information System (FTIS) software developed by the Florida Department of Transportation. At the start of this phase of the project, they identified the transit systems in each metropolitan area included in the study. The authors then obtained unlinked passenger trips, passenger miles, vehicle miles, revenue miles, and route miles (on a system-wide and mode basis) for each transit system. They were able to aggregate these data to develop regional measures of riding habit (passenger miles per capita) and load factor (passenger miles per vehicle mile), which they related to information contained in the timelines developed in phase one of the project. The authors were also able to develop system-based and mode-based ridership, service, average trip length, and service productivity trends for all agencies in all study areas. The timeframe for most of these descriptive analyses is 1984 to 2004. In the case of MARTA in Atlanta, they were able obtain data back to the agency's creation in the 1970s. Detailed information about data sources for this and other phases of the research is contained in the individual case studies in the appendixes.

Interviews with Key Informants

The third phase of the research project consisted of interviews with key informants. As interviewees, the authors selected individuals who were able to comment on the evolution of transit planning in the study area, the roles played by different types of services in facilitating the vision, the successes and/or failings of these different services, and the importance of land use or other non-transit strategies in affecting transit performance. Most interviewees held responsible positions in the primary transit agency or metropolitan planning organization in the study area. For most cases, the authors obtained interviews with two informants. they obtained interviews with three informants for Miami, and with one informant for San Diego and Salt Lake City. The names of interviewees are listed in the references for the relevant case study.

The authors used the analysis of qualitative and quantitative data from phases one and two of the project to develop a generic interview guide, which they then tailored to each metropolitan area and to each interview, so as to query and interviewee about issues for which he had some knowledge and/or expertise. They submitted the questions to our contact prior to the interview, and ultimately conducted interviews by telephone. The interviews lasted an average of 90 minutes. One member of the research team took the lead in asking questions, while the other member of the team listened, took notes, and raised issues that might have been missed in the course of conversation. The authors cite the interviews as sources of materials contained in both the main body of the report and the individual cases.

Detailed Case Study Analysis

The fourth phase of the research project involved a detailed examination of information gathered in the first three phases of the project, plus additional information gathered from metropolitan planning organizations (MPO) or transit agencies. From MPOs, the authors obtained information about regional population and employment patterns which they used to generate population and employment tables and density maps for the case study analysis. From transit agencies, they obtained route-based performance statistics, transit passenger on-board surveys, and rail station boarding and alighting data that allowed them to develop a finer picture of the types of services that are performing well in each area and the degree of integration of bus and rail services. The authors also obtained geographic information system data from MPOs and transit agencies that allowed us to map these data. They were able to use the detailed case study data to make comparisons across their study areas to highlight instances where transit agencies were enjoying ridership and performance success (and those where they were not) as well as the likely reasons for their success (or failure). The information presented in this report represents the results of all four phases of the project.

GUIDEBOOK TO SUCCESSFUL RAIL TRANSIT PERFORMANCE

INTRODUCTION

This investigation of the role of service planning decisions in promoting rail transit success or failure focused on the experiences of eleven metropolitan areas with between 1 million and 5 million persons that have rail transit. These metropolitan areas include: Atlanta, Georgia; Dallas-Fort Worth, Texas; Denver, Colorado; Miami, Florida; Minneapolis-St. Paul, Minnesota; Pittsburgh, Pennsylvania; Portland, Oregon; Sacramento, California; Salt Lake City, Utah; San Diego, California; and San José, California. The authors collected and examined a combination of documentary evidence and statistical data, and conducted interviews with key informants in each study area. The resulting case study narratives are included as appendices for this project report.

This guidebook represents a compilation of the key insights gained in the course of the research, and draws from the findings of the various case studies. These findings tell the reader how rail transit can be used to advantage and disadvantage in improving the benefit that transit brings to the region. The purpose of this guidebook is to share these lessons with those seeking to improve the role of transit in their metropolitan areas. The authors thus hope the guidebook can be of benefit to planners, policymakers, and scholars interested in rail transit planning issues.

The guidebook begins with a brief discussion of two distinct visions of transit system development that involve differences in system structures and the role that rail transit should play in the overall transit system. The guidebook continues with a brief overview of performance trends in each of the eleven metropolitan areas. This discussion allows the authors to highlight the metropolitan areas where rail transit is contributing favorably to overall transit performance and/or performing well on its own versus those metropolitan areas with weaker performance. The authors then take the reader through a discussion of the key factors that they believe explain the variation in transit performance among the study areas. These factors include: 1) transit system orientation; 2) the role of rail transit as a regional transit system's backbone; 3) the importance of tapping non-CBD markets; 4) the important role played by transfers in extending the reach of the regional transit system; and 5) the importance of serving regional destinations. In the course of discussing these issues, the authors also note: 1) the importance of calculating transfer rates correctly; and 2) two cautionary tales illustrating that rail transit alone is not a guarantee for transit success. They close the guidebook with brief reflections on the most successful of the study cities, Portland, and the reasons for its success.

TWO VISIONS OF TRANSIT SYSTEM DEVELOPMENT

Transit performance in each of the 11 metropolitan areas is the result of a combination of forces beyond the control of transit planners and policymakers, including the historical pattern of urban development and regional economic trends, and those within the control of these same individuals, most critically the vision of how transit should serve the metropolitan area. There are, of course, different visions of transit system development, and these visions include different ideas about the role rail should play within the transit system's family of modes. Some metropolitan areas articulate a central business district (CBD) focused vision, on the premise that the primary transit market consists of commuters headed to jobs in the CBD. These metropolitan areas structure their networks to focus on the CBD like spokes on a wheel (radial service structure). They tend to provide a higher level of service during the peak periods than at other times of the day, but often only in the peak travel direction. Premium services tend to be express bus services operating from suburban park-and-ride lots or through affluent suburban neighborhoods directly to the CBDs in the morning and returning in the evening. Rail service is relatively unimportant in these systems and tends to function as a higher level of bus service, typically in only one corridor.

Other metropolitan areas articulate a multidestination vision, on the premise that the transit market consists of a mix of passengers traveling for varying purposes at different times of the days to many different parts of the metropolitan area. These metropolitan areas disperse their service throughout their networks, and thus the transit systems are less CBD-focused. In these systems, rail lines replaced many of the bus routes that formerly traveled to the CBD. Bus routes tend to be more focused on rail stations in the suburbs, both feeding passengers to CBD-bound trains, but also distributing train passengers to suburban destinations. Transfers are important, designed to expand the number of destinations that passengers may reach. In such systems, rail lines sometimes function as regional distributor lines, absorbing passengers from connecting bus services in the suburbs and distributing these passengers to important destinations or to important bus transfers in many parts of the regions.

Most case studies lie somewhere in between these two archetypal visions or are in transition between them. Minneapolis-St. Paul, for example, has been an exemplar of the first archetype for most of its transit history but recently opened a new light rail line in one corridor. Within that corridor it has restructured its bus services around the new light rail line according to principles inherent in the second archetype, and enjoyed ridership and productivity improvements on its services in the corridor. Sacramento, on the other hand, followed the precepts of the second archetype when it first opened its light rail service in the late 1980s but has shifted more toward the precepts of the first archetype with its newer light rail extensions, with disappointing performance results.

ASSESSMENT OF TRANSIT PERFORMANCE IN 11 METROPOLITAN AREAS

The authors first offer a brief portrait of transit performance in the set of 11 metropolitan areas. They used two primary measures of transit performance throughout the study: riding habit and service productivity. Riding habit is the number of passenger miles per capita. Service productivity, or load factor, is the ratio of passenger miles to vehicle miles.

Regional riding habit and service productivity vary widely among the 11 metropolitan areas (see Figure 3 and Figure 4). In 2004, six metropolitan areas had regional riding habit of 100 passenger miles per capita or higher. In more than half the metropolitan areas, riding habit has increased since 1984. In Dallas, Denver, Miami, Portland, Salt Lake City, and San Diego, ridership increased faster than population (see Table 4). The metropolitan areas with the largest percent increases in riding habit were (in rank order) Portland, Miami, San Diego, Salt Lake City, and Denver.

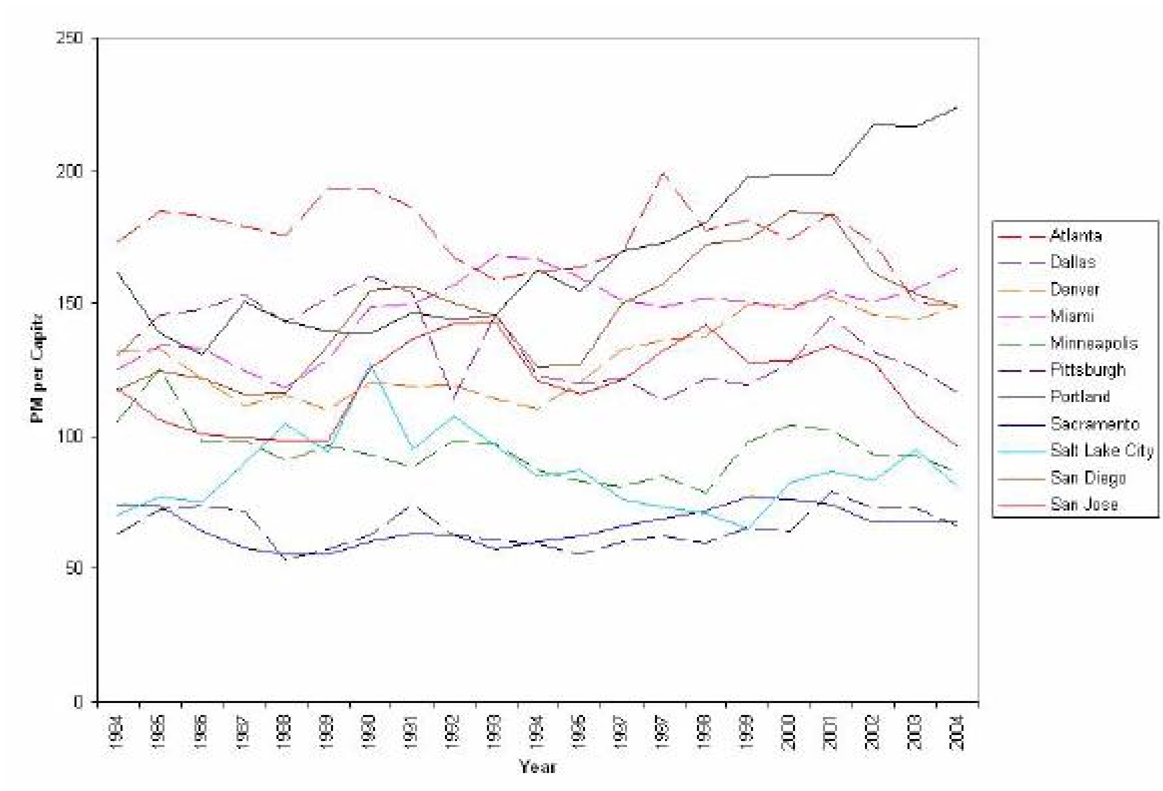


Figure 3 Riding Habit for Case Study Areas (1984–2004)

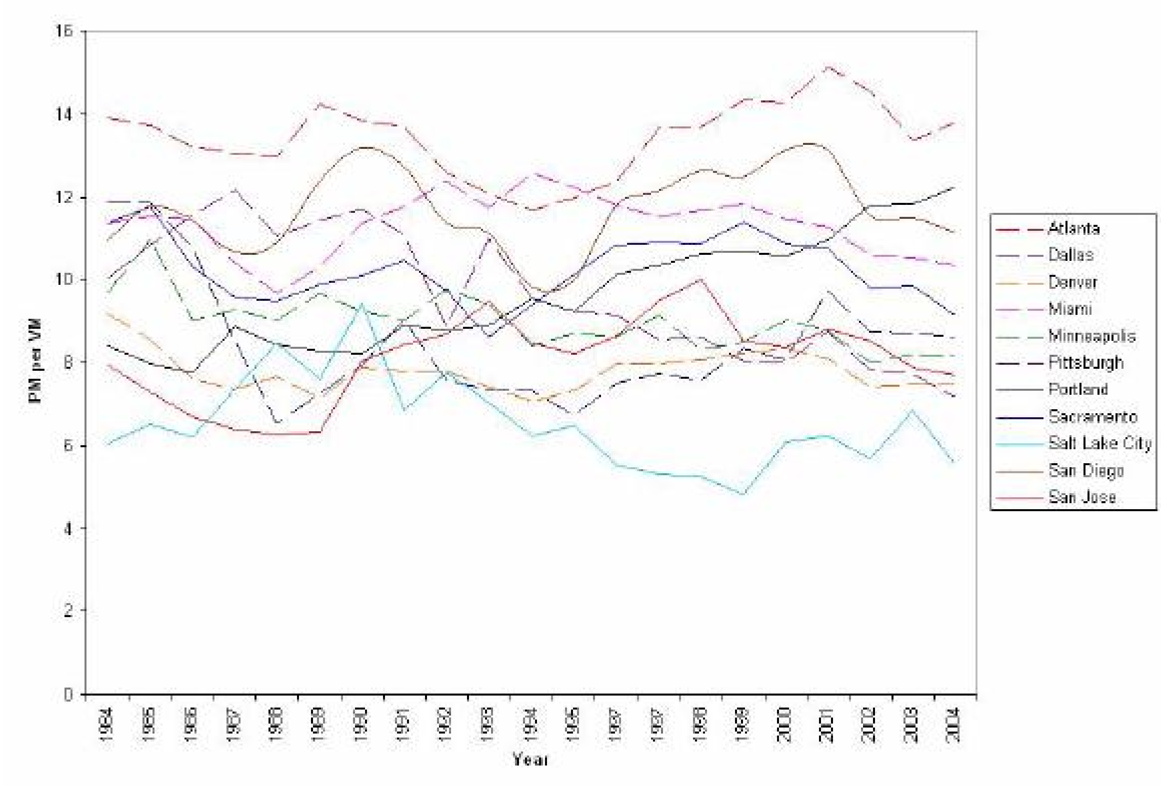


Figure 4 Service Productivity for Case Study Areas (1984–2004)

In Portland and San Diego, ridership has increased faster than service has increased, resulting in increased service productivity (see Table 4). A third metropolitan area, Atlanta, has maintained high service productivity throughout the period. These three metropolitan areas had service productivity above 10 passenger miles per vehicle mile in 2004. The only other metropolitan area with this level of productivity was Miami (whose productivity declined 9% between 1984 and 2004).

Table 4 Regional riding habit and service productivity by MSA

MSA	Riding Habit (PM per Capita)			Service Productivity (PM per Capita)		
	1984	2004	Percent Change	1984	2004	Percent Change
Atlanta	173.06	149.07	-13.86	13.88	13.79	-0.72
Dallas	63.33	66.12	4.40	11.86	8.60	-27.50
Denver	131.74	149.01	13.11	9.17	7.47	-18.51
Miami	125.14	163.80	30.90	11.38	10.34	-9.13
Minneapolis	105.62	86.36	-18.24	9.70	8.19	-15.63
Pittsburgh	130.46	116.43	-10.75	10.05	7.18	-28.59
Portland	161.89	223.71	38.19	8.41	12.25	45.53
Sacramento	74.41	67.66	-9.07	11.35	9.14	-19.52
Salt Lake City	70.66	80.66	14.15	6.05	5.56	-8.11

Table 4 Regional riding habit and service productivity by MSA

MSA	Riding Habit (PM per Capita)			Service Productivity (PM per Capita)		
	1984	2004	Percent Change	1984	2004	Percent Change
San Diego	117.19	148.87	27.03	10.95	11.15	1.77
San José	117.64	96.28	-18.16	7.93	7.70	-2.86

Note: PM = Passenger Miles

Source: Regional Riding Habit and Service Productivity Graphs in Case Studies.

The transit systems in each metropolitan area consist of a mix of bus and rail services, and one can examine the performance of the two modes in isolation. Table 5 reports average weekday performance statistics for bus routes operated by the primary transit agency in each metropolitan area. The table reports two measures of route performance: (unlinked passenger) trips per revenue hour and (unlinked passenger) trips per revenue mile. The table also differentiates between bus routes that serve the CBD in the metropolitan area versus routes that do not serve the CBD. The numbers in the table represent median values for each class of bus routes.

Table 5 shows that bus routes that serve the CBD are generally more productive than their non-CBD counterparts. One might draw the conclusion from these data that serving non-CBD destinations is not an effective strategy. However, this is an incorrect conclusion for three reasons. First, for most metropolitan areas the non-CBD routes' productivity, while lower than that of CBD-focused routes, approaches that of routes serving the CBD. Second, and more importantly, most passengers using bus (and rail) routes going to the CBD are not in fact destined to the CBD. They get off the bus before it arrives at the CBD, or they ride through the CBD and get off somewhere beyond it.

Table 5 Average weekday bus route of primary transit agency by MSA

MSA	Transit Agency	Trips per Revenue Hour (Median)			Trips per Revenue Mile (Median)		
		All Routes	CBD Routes	Non-CBD Routes	All Routes	CBD Routes	Non-CBD Routes
Atlanta	MARTA	28.70	29.05	28.62	2.29	2.62	2.21
Dallas	DART	20.22	24.08	18.07	1.35	1.53	1.26
Denver	RTD	21.20	26.59	16.56	1.07	1.41	0.82
Miami	MDT	22.11	30.39	15.86	1.60	2.51	1.29
Minneapolis	Metro Transit	40.62	41.05	34.15	2.11	2.15	1.51
Pittsburgh	PAT	18.98	19.97	13.20	1.31	1.35	0.99
Portland	Tri-Met	33.80	38.00	28.00	n.a..	n.a.	n.a.
Sacramento	RT	24.40	26.09	22.94	2.12	2.24	1.94
Salt Lake City	UTA	n.a.	n.a.	n.a.	1.09	1.09	1.10
San Diego	MTS	27.40	30.90	26.70	1.75	1.89	1.69
San José	VTA	16.95	21.71	16.52	1.32	1.71	1.28

Source: Bus Route Performance Tables in Case Studies.

Finally, looking at bus route performance in isolation is misleading. In most cases rail services are more productive than bus services (see Table 6). A region that has truncated (at suburban rail stations) many of its bus services that previously went into the CBD may end up with the remaining bus services being less productive than before the rail service was put in, but there will be less bus service operating at the lower productivity, and more rail service operating at higher productivity. Overall transit productivity will have improved. This indeed has been the case in Atlanta, Miami, Portland, San Diego, and Dallas. The metropolitan area with the highest bus productivity, Minneapolis-St. Paul (see Table 5) was not the most productive in terms of overall transit productivity (see Table 4 and Figure 4). In fact, Minneapolis-St. Paul began the period in 1984 in the middle of the productivity pack, and by 2004 its productivity had declined to the lower middle part of the pack.

Table 6 Rail service productivity for primary transit agency by MSA

MSA	Agency	Rail Productivity		
		1984	2004	Percent Change
Atlanta	MARTA	25.89	19.98	-22.83
Dallas	DART	n.a.	23.52	n.a.
Denver	RTD	n.a.	11.10	n.a.
Miami	MDT	12.66	13.15	3.87
Minneapolis	Metro Tratnsit	n.a.	23.67	n.a.
Pittsburgh	PAT	16.23	19.89	22.55
Portland	Tri-Met	n.a.	29.75	n.a.
Sacramento	RT	n.a.	19.38	n.a.
Salt Lake City	UTA	n.a.	22.03	n.a.
San Diego	MTS	27.57	24.07	-12.69
San José	VTA	n.a.	11.98	n.a.

Note: For Miami, rail only includes heavy rail. For San Diego, rail includes only light rail.

Source: Service Productivity Tables in Case Studies section.

Based on the standards the authors propose in the introductory chapter, two metropolitan areas emerge from the analysis of transit performance as unqualified successes: Portland and San Diego. Portland is clearly a success. It ended the period with the largest riding habit while also experiencing the largest percentage growth in riding habit. It also experienced a very large increase in productivity, ending up with the second most productive transit among the cases.

San Diego also is a success. Its riding habit increased by almost 30%, ending the period almost tied with Denver and Atlanta, but lower than Portland and Miami. Its productivity, relatively high to begin with, also improved, but only slightly. All of this is despite San Diego slipping significantly from 2002 through 2004 in both riding habit and productivity. (San Diego today likely is higher on both these counts. The authors obtained special passenger tallies from 2003 through 2007, showing very strong ridership growth between 2004 and 2007 inclusive of all its modes, as discussed in the case study.)

The other metropolitan areas offer a more mixed record. In general, those metropolitan areas that have a more multidestination vision and have leveraged their rail investments to bring about that vision (San Diego, Portland, Miami, and Atlanta) have been the most productive. They also have enjoyed the best record in riding habit. Those metropolitan areas with relatively minor rail services set in a system with a CBD-express bus focus (Pittsburgh and Minneapolis-St. Paul) have lower overall regional transit productivity and less encouraging riding habits.

Those metropolitan areas that have introduced very good rail services but have continued to operate bus services in competition with them (Salt Lake City, Sacramento in terms of its more recent rail extensions, and Pittsburgh) generally have obtained good results for their rail lines but poor results with their bus systems, with an overall depressing effect on regional transit performance. These systems generally have viewed bus and rail systems as competitive, and they let the passenger decide what mode of transit is best for their particular trip. The result has been duplicative service between many suburban points and the CBD and the absence of service, or very inconvenient service to other destinations. This condition has produced low productivity primarily for the bus services.

TRANSIT SERVICE ORIENTATION IN 11 METROPOLITAN AREAS

Service orientation is the physical articulation of a region's transit vision. The authors measured service orientation by determining the relative distribution of the primary transit agency's service between CBD-serving and non-CBD bus routes. The higher the percentage of routes, miles, and hours apportioned to CBD-serving routes the more radial the system is in its function. Conversely, the more service apportioned to non-CBD serving routes the more multidestination the system is in its function. Table 7 describes the service orientation of the primary transit agency in each of the 11 study areas. The table shows that the metropolitan areas with the strongest CBD focus are Pittsburgh and Minneapolis-St. Paul, while the metropolitan areas with the most dispersed service are Atlanta and San Diego.

Table 7 Service orientation of primary transit agency by MSA

MSA	Transit Agency	CBD-Focused Bus Service			Non-CBD Bus Service		
		Bus Routes	Percent Revenue Hours	Percent Revenue Miles	Bus Routes	Percent Revenue Hours	Percent Revenue Mile
Atlanta	MARTA	24	18.16	17.47	108	81.84	82.53
Dallas	DART	45	45.01	46.17	83	54.99	53.83
Denver	RTD	62	49.69	41.02	94	50.31	58.98
Miami	MDT	34	42.91	40.01	72	57.09	59.99
Minneapolis	MetroTransit	152	93.60	92.62	55	6.40	7.38
Pittsburgh	PAT	174	84.61	86.71	39	15.39	13.29
Portland	Tri-Met	48	66.49	64.55	46	33.51	35.45
Sacramento	RT	26	39.75	36.08	51	60.25	63.92

Table 7 Service orientation of primary transit agency by MSA

MSA	Transit Agency	CBD-Focused Bus Service			Non-CBD Bus Service		
		Bus Routes	Percent Revenue Hours	Percent Revenue Miles	Bus Routes	Percent Revenue Hours	Percent Revenue Mile
Salt Lake City	UTA	46	N.A.	47.19	62	n.a	52.81
San Diego	MTS	31	35.92	33.74	126	64.08	66.26
San José	VTA	24	46.52	47.51	50	53.48	52.49

Note: These breakdowns refer to average weekday service, and includes only bus routes for which service data are available.

For Minneapolis, the MPO defines three CBDs: Minneapolis, St. Paul and the University of Minnesota. Service focuses on Minneapolis CBD alone represents approximately 85% of service.

Source: Individual MSA Case Studies.

Examining the case studies, one can see three aspects to service orientation that affect patronage. One is the degree to which routes are structured to achieve multidestination riding capability. Second is the extent to which such routes cover the entire region. Third is the degree to which a network of higher-speed regional routes, that have stops serving regional destinations as well as connecting with other regional routes, overlays the local service.

San Diego's Service Concept Element, adopted two years before the first light rail service began operating, is an archetype that encompasses all these qualities (see Figure 5). The unifying concept here is a grid of regional routes interconnecting all the major destinations in the region. These routes were envisioned to be fast (20 to 30 miles per hour, including stops), to have stops connected to major destinations by pedestrian bridges and paths, and to have stops where the various regional routes interconnect with each other and with local routes. None of the 11 case studies, including San Diego, actually has fully achieved such an archetype, but partial achievement is represented in several of the case studies.

In San Diego several of the regional routes shown in Figure 5 have been realized as light rail transit lines (see lower left panel, Figure 6). These lines generally have stops one to two miles apart, the stops are fairly well connected to major activity centers, and many stops provide convenient transfers with other light rail lines as well as local buses, by which passengers can reach additional destinations. Service speeds are in the range of 20 to 30 miles per hour. As the light rail lines have opened, they have replaced numerous bus routes. Thirty years ago almost all bus routes in the region focused on the San Diego CBD. Today, only about 36% of the transit service, now bus and rail, focuses on the CBD (see Table 7).

San Diego has performed well on all transit performance indicators for the region as a whole. The light rail lines are the strongest performers in the network, accounting for 17% of the metropolitan area's service but carrying 35% of its passengers (see Table 8 and Table 9). The weakness in San Diego is that where light rail lines do not exist, there is no regional network. The Service Concept Element envisioned that some regional routes would be operated with buses that stopped at on-freeway stations connected to adjoining land uses by pedestrian bridges. While there are express buses in several corridors today, the express buses do not meet the attributes of regional service. If the buses are fast, they achieve their speed by not making intermediate stops, thus providing limited accessibility. If they make intermediate stops to serve important destinations and transfer connections, they lose a huge amount of time getting off and on the freeways to do so. As a consequence, their patronage is much less than light rail patronage in comparable corridors. There also is a commuter rail line extending from the CBD northward about 45 miles to Oceanside. It is fast, and in addition to one stop serving the CBD, it has two other stops serving major non-CBD activity centers and connecting with regional services. However, the service is infrequent, and patronage is not high.

Portland's service orientation is similar to San Diego's (see upper right panel, Figure 6. Its light rail lines function as a limited regional network that are well situated with respect to major regional destinations in addition to serving the CBD. The local bus network is well integrated with the light rail line; as in San Diego, as is show later, the most heavily patronized rail stations are transfer connections with heavily-patronized local bus lines. Although Portland has a relatively high percentage of its remaining bus routes heading to the CBD, its most heavily patronized bus routes do not serve the CBD. These operate on north-south arterial roads lined with strip commercial development located a number of miles east of the CBD. Denver also features a grid of bus routes that operate along major arterial roads (see upper left panel, Figure 6). However, Denver's bus routes deviate from the grid to enter major activity centers such as the CBD, imposing significant time penalties on riders bound to other destinations.

One can see similar service orientations in Atlanta, Dallas, and Miami. The transit systems in these three metropolitan areas constitute partial regional networks that function well in the parts of the region where they exist, but regional performance suffers because the networks do not extend to serve all important destinations. In Atlanta, for example, the major transit system (MARTA) serves only part of the metropolitan area's core (see left panel, Figure 7). Riding habit is growing in the part of the region that MARTA serves, where service is characterized by local bus routes feeding into and distributing passengers from the regional network, which happens to be a rail rapid transit system. More than 80% of MARTA bus service does not go to the Atlanta CBD (see Table 7). Over the years as rail lines have opened, MARTA has cut back the trunk parts of its bus routes, removing duplicative bus service. While this move forced passengers to transfer to trains, it also opened new travel markets. The bus routes now accept passengers from trains and take them to destinations as well as feed passengers to trains. In 2004, rail accounted for 43% of MARTA's service but carried 62% of its riders (see Table 8 and Table 9). Atlanta's service productivity is highest among the eleven study areas. However, riding habit has declined since 1984, primarily because of growth in employment outside the MARTA service area.

The Miami metropolitan area features two transit systems that are structured as multidestination grids: Broward County Transit (BCT) and Miami-Dade Transit (MDT). BCT undertook a major service restructuring in the 1990s that removed service from neighborhoods and placed it on arterial roads (see Figure 8). The result has been a dramatic increase in service productivity. One of the interviewees noted that in 1986, BCT had 205 buses and carried 50,000 passengers per day. In 2000, they had 205 buses and carried 100,000 passengers per day. The cost per trip was down to $1.80. The key to BCT's success is higher frequency service on its arterial roads. Indeed, arterial roads with strip commercial development are sizeable ridership markets in the Miami MSA, which BCT has successfully tapped in corridors like U.S. Route 441 (a north-south arterial) and U.S. Route 1 (also a north-south route), the sites of its two most heavily patronized bus routes.

BCT's strong performance is particularly striking compared to second-ranked operators in other metropolitan areas, such as the T that serves Fort Worth, Texas in the Dallas-Fort Worth metropolitan area. The T concentrates its service on a traditional CBD using a radial network (see right panel, Figure 7). In contrast, BCT features a decentralized grid that serves many important destinations. BCT enjoys much higher ridership and better service productivity than the T, and is enjoying ridership and productivity increases in recent years where the T has experienced declining ridership and productivity.

Miami-Dade Transit carried out service restructuring as part of the Network 86 initiative in 1986, also moving to a grid network (see Figure 9). MDT experienced significant productivity gains from the restructuring, but also encountered severe political opposition that has dampened its enthusiasm for subsequent major service changes. Both BCT and MDT function well as individual entities within the Miami metropolitan area, but the region lacks a unifying element to tie the various agencies (and their services) to one another. The Tri-Rail commuter rail service may become the region's transit backbone, particularly given recent increases in service frequency that could give it more than just a commuter-focused orientation.

Dallas-Fort Worth illustrates the differing effectiveness of multi-destination regional service versus radial local service. The Dallas half of the region is served by DART, which is a well-integrated bus and rail multi-destination system (see right panel, Figure 7). DART ridership and productivity have been increasing since light rail service was first introduced. Today the light rail line provides 14% of the region's service but carries over 30% of the region's riders (see Table 8 and Table 9).

The other major transit agency in the Dallas-Fort Worth metropolitan area, the T, serves the western half of the region. It features a classic radial pattern of local bus routes focused on the Fort Worth CBD. Ridership in the Fort Worth area has decreased since 1984. The commuter rail line linking Dallas and Fort Worth, TRE, suffers from not having intermediate stops connected to bus services to the major and growing area of employment in Arlington, which currently is without any type of transit service. The main problem with transit performance in the Dallas-Fort Worth area is that DART-type service does not span areas of major destinations in the entire region.

Four other metropolitan areas have not developed integrated, multidestination bus-rail transit systems, with the consequence that they do not enjoy the high riding habit and/or service productivity seen in other metropolitan areas. These metropolitan areas are: Minneapolis-St.

Paul, Pittsburgh, Sacramento, and Salt Lake City (see Figure 11). Minneapolis-Saint Paul enjoys high bus productivity, but poor overall regional performance. Here, light rail transit is a very small part of a regional transit network that relies heavily on CBD-focused express buses; these express bus services have seen declining ridership and productivity as the CBDs they serve have been in relative decline as major activity centers.

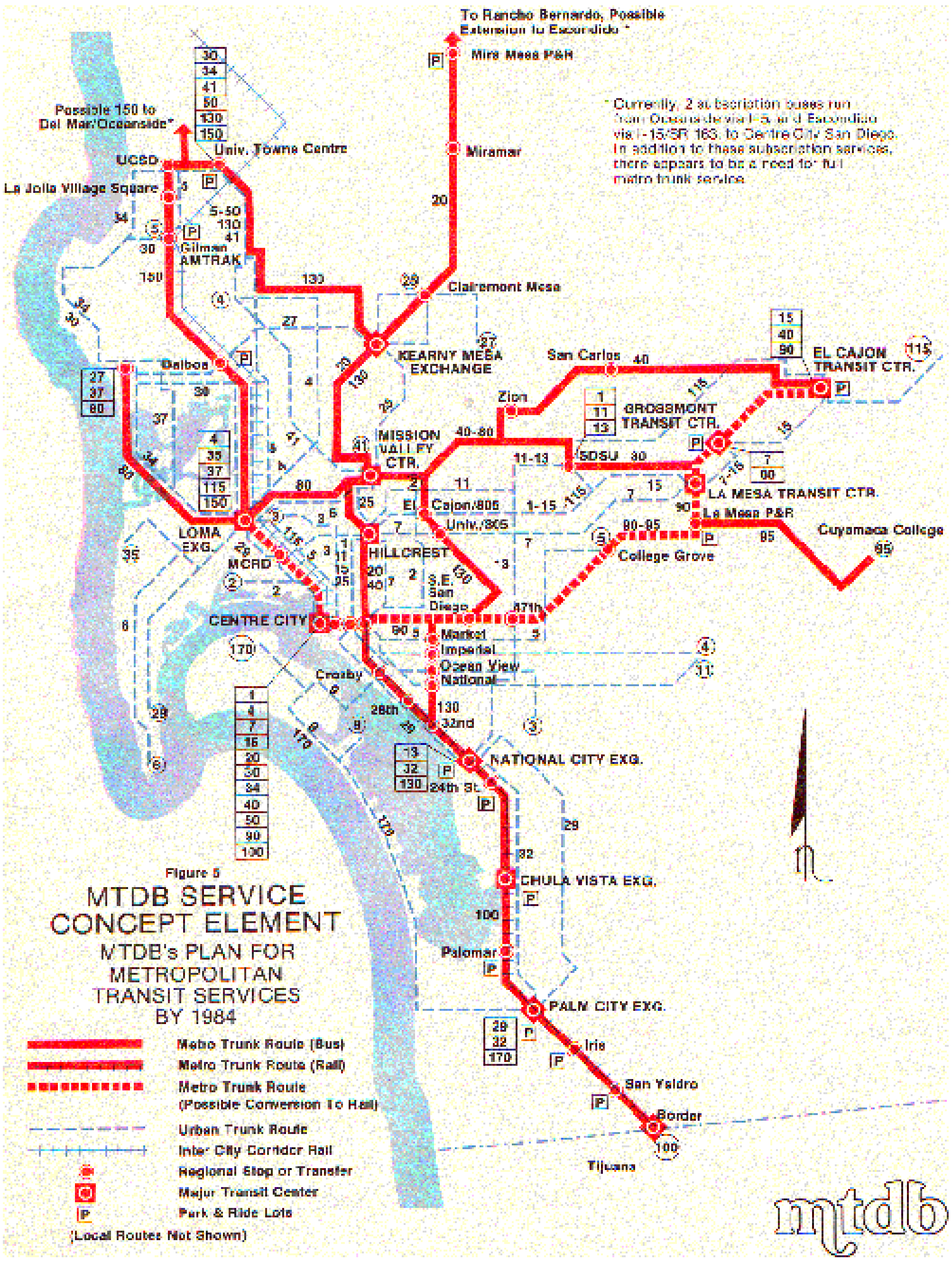


Figure 5 The regional service concept for San Diego

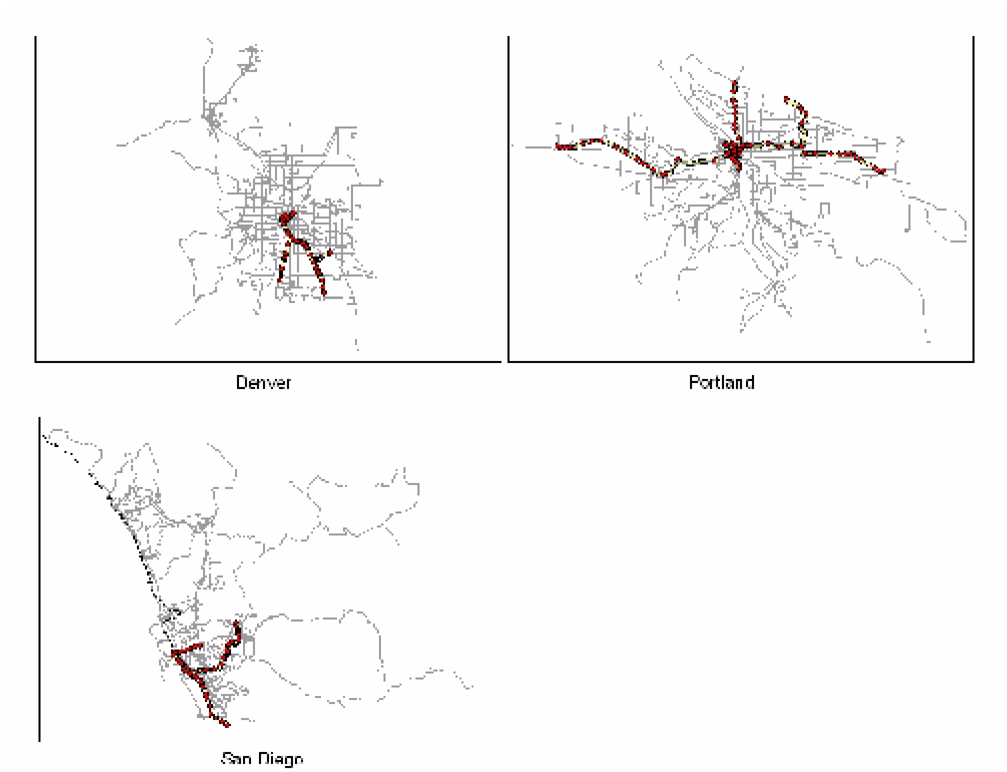


Figure 6 System maps for successful metropolitan areas

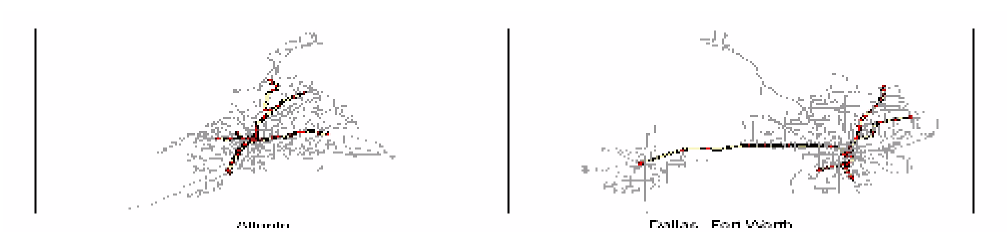


Figure 7 System maps for metropolitan areas that lack regional transit systems

In Pittsburgh, The Port Authority of Allegheny County Transit (PAT) focuses largely on serving a CBD-commuter market, and has captured a large (50%) share of this declining travel market. PAT has not achieved success in taking transit patrons to other destinations outside the central core, a record standing in stark contrast to that of most other metropolitan areas that were studied. Pittsburgh's light rail transit is also a very small part of the region's service, although it carries a disproportionate share of the region's riders (see Table 8 and Table 9).

The rail line is treated as just another radial transit service to the CBD, which happens to be on tracks rather than on the road. There is no attempt to make use of this major investment to reach other more destinations or improve transit system ridership or system productivity, which is poor due to the very poor performance of PAT's bus routes. Pittsburgh has also invested heavily in three busways focused on providing rapid peak-hour bus service from commuter neighborhoods into downtown Pittsburgh. These major transit investments have done little to facilitate transit travel to other transit destinations in the region, however, and little such travel has materialized.

Figure 8 Multidestination transit system in Broward County, Florida

Sacramento is a metropolitan area characterized by two distinct periods of transit planning, with different philosophical underpinnings that can be seen in the structure of the region's transit network. During the early period of light rail transit development, Sacramento engaged in integrated, multidestination transit service planning. The transit agency coordinated bus and rail services to feed one another, with positive ridership and productivity results. The most recent light rail transit expansions, to the south and in the eastern corridor to Folsom, have been implemented without the same kind of careful planning about connecting rail patrons (via bus service) to their final destination. Bus service has also taken on more of a CBD-focus in recent years, in stark contrast to the earlier multidestination focus. Consequently, Sacramento has not enjoyed the ridership increases or productivity improvements in recent years that it experienced earlier. The region's riding habit and service productivity have both fallen.

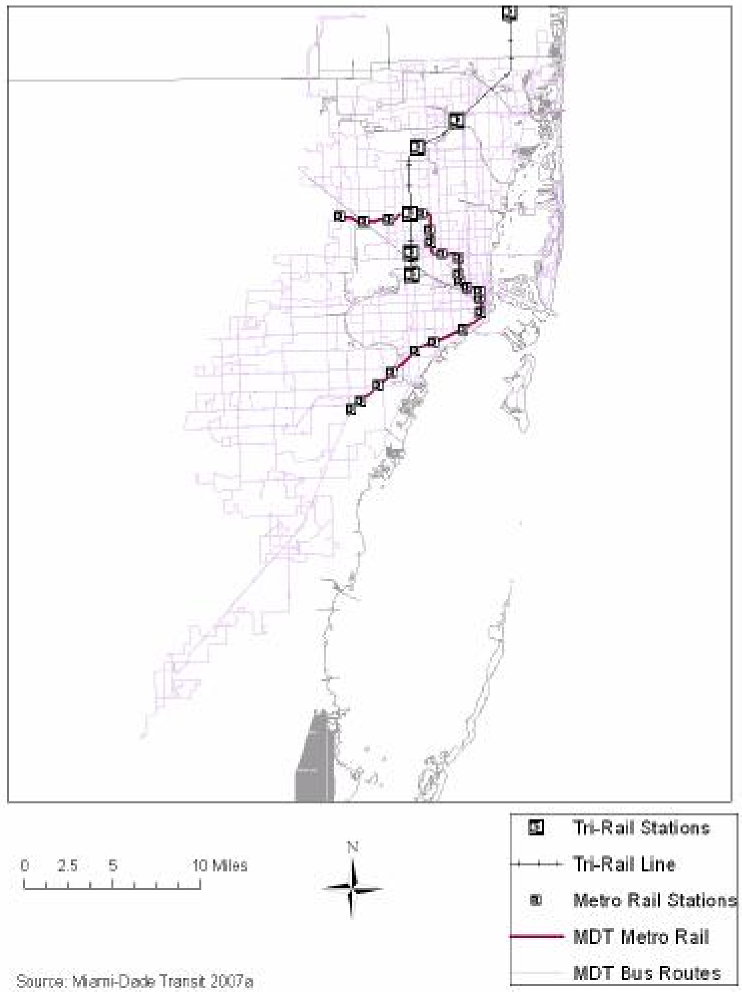


Figure 9 Multidestination transit system in Miami-Dade County, Florida

Salt Lake City is an example of a city that implemented its rail investment very differently from successful cities such as Atlanta, Dallas, and San Diego. Those cities used rail transit as a tool to improve overall transit service productivity, which required large scale alternations to the bus networks when rail transit was implemented. The downtown portions of bus routes in those cities were discontinued when rail transit was implemented. Instead, bus passengers going downtown were required to transfer to trains to complete their trips. As was observed in those cities, the changes to the bus system actually did result in improved transit productivity.

In contrast, in Salt Lake City LRT is used as an enhancement to a bus system that largely remained unchanged from its pre-rail configuration. As a consequence, passengers are not forced to make a transfer, and they choose the mode that is best for their particular trip. The result has been that many former bus passengers in Salt Lake City have stopped using the bus altogether. Because the same amount of bus service still runs with fewer passengers, bus productivity has fallen. The absence of bus route restructuring in Salt Lake City means that the system serves no new destinations. Thus, there are no new bus passengers to replace those who have stopped using the bus to take the train instead.

In conclusion, the authors' analysis indicates that the most successful metropolitan areas embraced the multidestination service philosophy and applied it on a regional scale. In the most successful metropolitan areas, transit patrons can use a combined bus-rail transit system to easily reach a wide array of destinations both inside and outside the CBD. Less successful metropolitan areas do not present the same array of travel options to their patrons. Some focus most of their service on the CBD, which is a declining activity center. Others do not integrate their bus and rail services to feed one another. Still others embrace an integrated, multidestination vision, but apply it on a less-than-regional scale. In each of these cases, the net result is lower riding habit and service productivity, in short lower transit performance, than the region might otherwise have enjoyed.

THE ROLE OF RAIL TRANSIT AS A SYSTEM'S BACKBONE

The most successful metropolitan areas rely heavily on rail transit as the backbone to the metropolitan transit system. In these areas, rail carries a disproportionate share of riders compared to the proportion of service that it represents. It does so not only because of its higher carrying capacity than bus, but also because it plays an important role moving passengers throughout the larger transit network. In metropolitan areas like Atlanta, for example, the rail system serves as a trunk line and the extensive bus network serves as a feeder and distribution system for the region.

The relative importance of bus and rail within the metropolitan transit system is presented using the statistics in Table 8 and Table 9. Table 8 summarizes the relative shares of total service accounted for by bus modes and rail modes in each of the study areas in 1984 and 2004, and the percent change in these shares between 1984 and 2004. Table 9 presents the same type of information for shares of total riders.

In five metropolitan areas, rail service accounts for more than 15% of the total service the primary transit agency provides (Atlanta, Miami, Portland, Sacramento, and San Diego). In two of these metropolitan areas (Portland and San Diego), rail transit carries more than twice the share of agency's riders as it consumes of the agency's service. These two metropolitan areas are among the most successful of the case studies. In several of the other metropolitan areas, similar ratios hold. The most striking case is that of Salt Lake City where rail is a mere 13% of the UTA's service but carries more than half its riders. However, in this case, very low bus route productivity explains the high ratio (as noted earlier).

The experience of San Diego illustrates the important role that rail transit plays in enhancing regional patronage and productivity. Figure 12 displays passenger activity in 2005 at bus stops and rail stations in San Diego. (This figure exhibits data collected before the eastern part of the Mission Valley light rail line opened.) The overwhelming majority of stations that stand out to the eye as the major points were transit patrons are boarding transit vehicles are light rail stations where there are large volumes of passengers transferring between modes. It also shows the relatively low usage of stops in the regional bus corridors. In general, the figure shows that the rail, but not the bus, part of the region's original transit vision largely has borne fruit.

Today, the three San Diego light rail routes carry around 110,000 passengers per day, and patronage continues to grow at a brisk pace. The regional corridors where light rail has not yet been built are served by express buses, but patronage lags by comparison. In these corridors, the buses leave the freeway to make stops at important en-route destinations and transfer centers. The highest patronage experienced by these freeway express routes is in the employment-rich I-15 corridor stretching north from the CBD to Escondido, noted as Route 20 in Figure 5 shown earlier. Variations of Express Bus 20 serve this corridor throughout the day and on weekends, and they are supplemented by peak period service on three express bus routes. In total these routes board about 5,600 passengers per weekday, considerably less than the roughly 20,000 to 50,000 passengers carried daily on each of the light rail lines.

A different approach is that of Pittsburgh where the transit system does not rely on rail transit as a system backbone, but instead relies on busway-based bus rapid transit service (see Figure 13). (In Pittsburgh, the LRT line functions simply as a higher-quality bus route.) Busway-serving routes tend to fan from the suburbs onto the busways and head into the CBD and then back out. The busways are exclusive bus-only facilities with on-line stations. The east busway serves the CBD and the Oakland area (three miles to the east). East busway patrons tend to be minorities. Most routes operating on the east busway are commuter-oriented routes with a strong peaking of patronage. However, the east busway also has a dedicated route running back and forth that has good ridership (13,000 per day) throughout the day in both travel directions.

The south busway travels through a largely residential area, and carries a middle class ridership. Many people access its service from park and ride lots. One interviewee characterized the south busway as having declining patronage. The west busway parallels a freeway and runs between the CBD and the western suburbs. The area is largely residential, although transit-oriented development is being examined near the Carnegie station. The west busway was intended to connect to the airport and planned to carry 50,000 riders per day, but cost overruns led to its truncation. The line carries about 9,000 riders per day, with ridership trending downward. One interviewee characterized the west busway clientele as a working class ridership.

Figure 10 System maps for metropolitan areas that have not fully leveraged rail transit

Table 8 Bus and rail service shares for primary transit agency by MSA

MSA	Agency	Bus Service as % of Total Service			Rail Service as % of Total Service		
		1984	2004	Percent Change	1984	2004	Percent Change
Atlanta	MARTA	82.49	56.82	-31.12	17.51	43.18	146.56
Dallas	DART	100.00	86.77	-13.23	N.A.	13.23	N.A.
Denver	RTD	100.00	92.49	-7.51	N.A.	7.51	N.A.
Miami	MTD	98.00	77.88	-20.53	2.00	20.02	902.21
Minneapolis	Metro Transit	100.00	98.59	-1.41	N.A.	1.41	N.A.
Pittsburgh	PAT	96.95	96.04	-0.95	3.05	3.96	30.07
Portland	Tri-Met	100.00	81.76	-18.24	N.A.	18.24	N.A.
Sacramento	RT	100.00	77.56	-22.44	N.A.	22.44	N.A.
Salt Lake City	UTA	100.00	86.83	-13.17	N.A.	13.17	N.A.
San Diego	MTS	92.42	79.70	-13.76	7.58	17.38	129.16
San José	VTA	100.00	90.40	-9.60	N.A.	9.60	N.A.

Note: Service share defined using proportions of total vehicle miles. For Miami, rail includes only heavy rail. For San Diego, rail includes only light rail.
Source: Service Tables in Case Studies.

Table 9 Bus and rail rider share for primary transit agency by MSA

MSA	Agency	Bus Riders as % of Total Ridership			Rail Riders as % of Total Ridership		
		1984	2004	Percent Change	1984	2004	Percent Change
Atlanta	MARTA	67.35	37.89	-43.75	32.65	62.11	90.23
Dallas	DART	100.00	64.05	-35.95	N.A.	35.95	N.A.
Denver	RTD	100.00	88.84	-11.16	N.A.	11.16	N.A.
Miami	MDT	97.88	69.59	-28.90	2.12	28.56	1,248.25
Minneapolis	Metro Transit	100.00	95.91	-4.09	N.A.	4.09	N.A.
Pittsburgh	PAT	95.14	89.28	-6.16	4.86	10.72	120.76
Portland	Tri-Met	100.00	57.07	-42.93	N.A.	42.93	N.A.
Sacramento	RT	100.00	54.31	-45.69	N.A.	45.69	N.A.
Salt Lake City	UTA	100.00	47.78	-52.22	N.A.	52.22	N.A.
San Diego	MTS	80.91	52.89	-34.63	19.09	38.08	99.50
San José	VTA	100.00	85.08	-14.92	N.A.	14.92	N.A.

Note: Ridership share defined using proportions of total passenger miles. For Miami, rail includes only heavy rail. For San Diego, rail includes only light rail.
Source: Ridership Tables in Case Studies.

The bottom line assessment of the Pittsburgh approach is provided by the poor patronage figures on these routes. Similarly poor patronage results afflict the recent regional express bus network implemented by Georgia Regional Transportation Authority in Atlanta, and the express bus routes discussed in San Diego earlier. The regional express bus system in Minneapolis historically has performed well, but in recent years its riding habit and productivity have been trending downward. In each of these cases, the ridership obtained by a CBD-focused express bus network has been quite small compared to the ridership obtained by rail transit services in similar corridors. The reason for the difference lies in the nature of the service and the destinations they serve. In the rail cases, they are part of integrated networks that enable people to transfer between bus and rail to reach an array of destinations-at most anytime of the day in all travel directions. In the express bus cases, the service links origins in the suburbs with destinations in the CBD, but usually only in the peak travel direction. The number of trips that move between these locations, in the direction and at the time the bus service operates, is quite small, and hence so is the patronage. These experiences should serve as cautionary tales for other metropolitan areas contemplating CBD-express bus type service development.

In conclusion, the authors' analysis indicates that the most successful metropolitan areas use rail transit as a backbone for their regional transit systems, around which they restructure their bus network. The rail then serves as a trunk line and the bus network as feeders and distributors for a system that provides riders with service to an array of travel destinations throughout the metropolitan area. Much less successful is an approach in which rail is a minor part of a larger CBD express bus based vision. Metropolitan areas that have adopted this approach have experienced lower-than-expected and/or declining patronage-even in corridors similar to those where rail has seen high or increasing patronage.

THE IMPORTANCE OF THE NON-CBD TRAVEL MARKET

Most transit agencies have long regarded the CBD as an important focal point for their transit service, and the widespread incidence of CBD-radial transit networks attests to the continuing popularity of this philosophy. However, the most successful metropolitan areas make a conscious effort to serve non-CBD destinations, because those are the parts of the metropolitan area that are growing and contain most of the destinations transit patrons wish to reach. Even CBD-serving transit routes carry a large number of patrons bound for non-CBD destinations, as was alluded to briefly when the authors introduced the bus route performance statistics shown in Table 5. These non-CBD bound patrons using CBD-serving routes may give transit agencies a misleading picture of their transit markets if they merely stop and observe that CBD-serving routes, for example, outperform their non-CBD serving counterparts without delving deeper into the data. The implication of this naïve view would be to increase the CBD service and cut back the less productive non-CBD service. The reality is that the non-CBD destinations are where most transit riders would like to go.

Data from San Diego illustrates the important role played by non-CBD destinations even on CBD-serving routes. Most transit routes in San Diego enjoy relatively high productivity, but those serving the CBD generally have higher productivity than the others. This fact suggests that the CBD exerts a modest positive effect on transit performance. It is important to understand, however, that most of the transit ridership even on the routes going to the CBD is not destined to the CBD. During the morning peak period, most patrons using routes going to the CBD get off their transit vehicles before the vehicles reach the CBD, or they ride completely through the CBD and alight at destinations far beyond it.

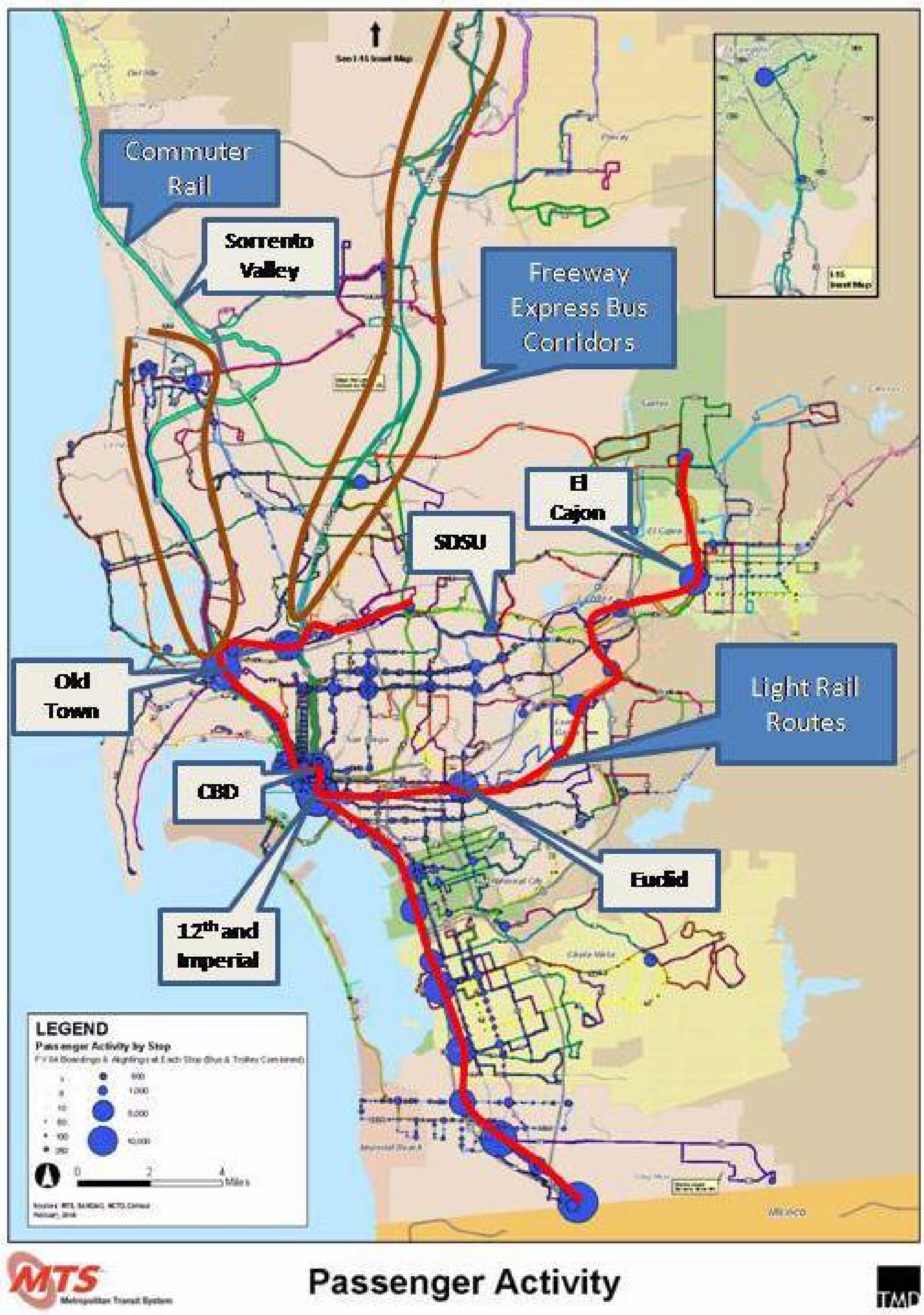


Figure 11 Passenger activity at San Diego rail stations and bus stops in 2005

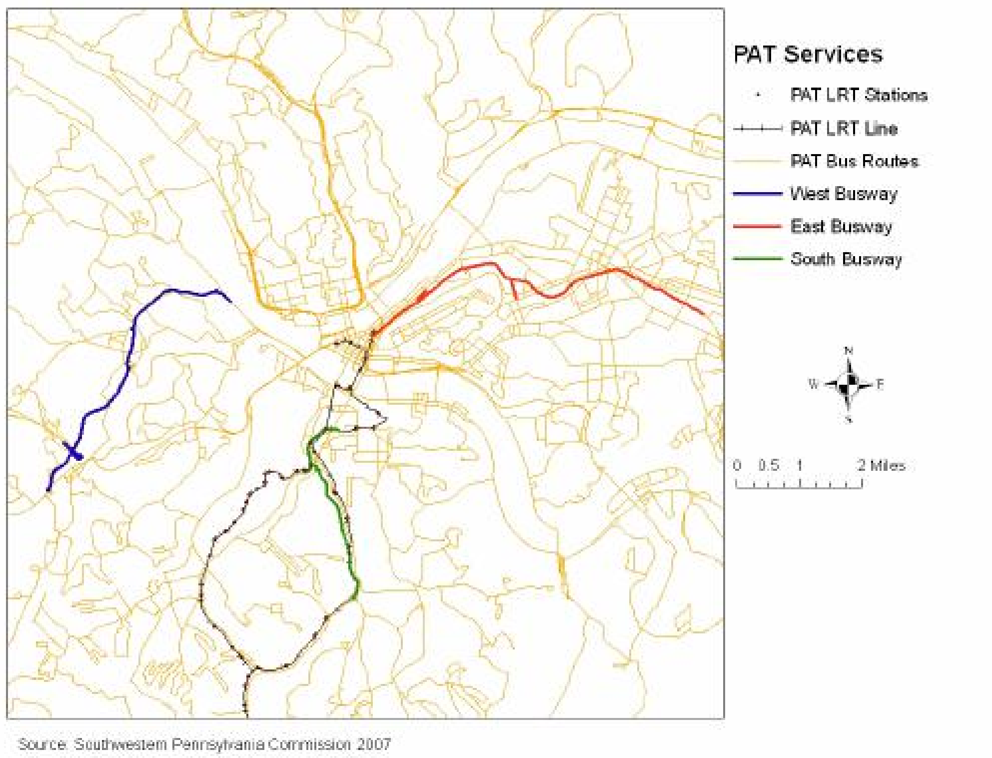


Figure 12 The busway/BRT backbone alternative: Pittsburgh, Pennsylvania

Table 10 reports morning peak period passenger alightings inside the CBD versus those outside the CBD for San Diego's CBD-serving bus and rail services in 2006. The table indicates that, of passengers on CBD-serving routes, 66% of LRT riders, 85% of express bus riders, 68% of commuter rail riders, and 77% of local bus riders alight at non-CBD destinations. The commuter rail, trolley (LRT), and even express buses gain their ridership strength by serving non-CBD destinations directly or through transfers to other services.

Table 10 Morning peak period passenger alightings for San Diego CBD-serving routes

Location	Type of Service			
	Trolley (LRT)	CBD-Serving Express Bus	Coaster (Commuter Rail)	CBD-Serving Local Bus
Inside CBD	6,687	400	670	2,517
Outside CBD	13,000	2,349	1,447	8,254
Total	19,687	2,749	2,117	10,771

Source: San Diego Associatoin of Governments. Transit Passenger Counting Program. Figures calculated from boardings and alightings of individual routes identified as serving CBD, FY 2006. Downloaded from http://pcp.santag.org/Home.aspx, Fall 2007.

The strength of the non-CBD market in San Diego is further attested to by the success of the Green Line, which does not serve the San Diego CBD. The Green Line is an east-west crosstown route serving largely auto-oriented commercial development, connecting the Old Town Transit Center on the west (where it intersects with the Blue Line, the Coaster, and a large number of bus routes fanning into the center from the north, west, and southwest) to an array of eastern destinations. In between it serves intense mall, big box, office building hotel/motel, apartment and condominium complexes, as well as San Diego State University. While the Orange Line (connecting the same eastern region stations served by the Green Line directly to the CBD) carried about the same ridership as the Green Line in 2006, it now appears that the Green Line patronage has overtaken that of the Orange Line. Green Line patronage fluctuates widely from month to month, because of sports events at Qualcom Stadium, which it serves conveniently, but a 12-month moving average of its patronage reveals a steadily rising secular trend that surpasses that of the Orange Line. In December 2007 the Green Line achieved 8.61 million annual boardings compared to the Orange Line's 7.96 million annual boardings.

The experience of Sacramento also attests to the strength of the non-CBD market among LRT patrons. The authors obtained passenger alighting data for downtown and non-downtown rail stations from the Sacramento transit agency. Figure 13 shows the LRT alignment, and circles in red the stations serving the downtown area. Table 11 provides alighting data for the Blue Line, while Table 12 provides the same data for the Gold Line. Combined, the two tables show that during the morning peak, roughly one-third of the rail system passengers alight from trains at downtown stations, and roughly two-thirds alight from stations in other areas. Thus, during the morning peak, roughly two thirds of RT light rail users are destined to places other than the downtown. Half of this latter number, that is, one-third of morning peak period light rail passengers, alight at stations in the central area of Sacramento but outside the downtown, but many of these are passengers transferring between the two light rail lines at the 16th Street Station.

The other one-third of the morning peak period light rail passengers alight from trains farther out on the two legs of the Blue Line and the one leg of the Gold Line. It is unknown what type of destinations these passengers ultimately reach, nor how they reach those destinations, but presumably many do so by bus connections. The tables also show that there is one set of stations where few passengers alight during the morning peak period. These are the four stations beyond Sunrise on the new light rail extension to Folsom, which are located in proximity to major employment centers. Some of these stations lack connecting bus service, and what service there is, in Folsom itself, tends to be poor.

Table 11 RT Gold Line weekday a.m. peak alightings

Downtown Stations		South Suburban Stations	
Station	**Alightings**	**Station**	**Alightings**
12th and I Streets	310	16th Street-Transfer Station	702
13th Street	103	47th Avenue	81
7th/8th & Capitol	314	4th/Wayne Hultgren	174
8th & O Streets	384	Broadway	329
Archives Plaza	281	City College	787
Cathedral Square	510	Florin	310
St. Rose of Lima Park	536	Fruitridge	118
		Meadowview	414
Subtotal	**2,336 (35.79%)**	**Subtotal**	**3,019 (46.26%)**
North Suburban Stations			
Alkali Flat/La Valentina	318		
Arden/Del Paso	222		
Globe Avenue	85		
Marconi/Arcade	122		
Roseville Rd.	18		
Royal Oaks	59		
Swanston	26		
Watt/I-80	322		
Watt/I-80 West	0		
Subtotal	**1,172 (17.95%)**		
Total (Downtown, South Suburban and North Suburban Stations)			**6,527 (100.00%)**

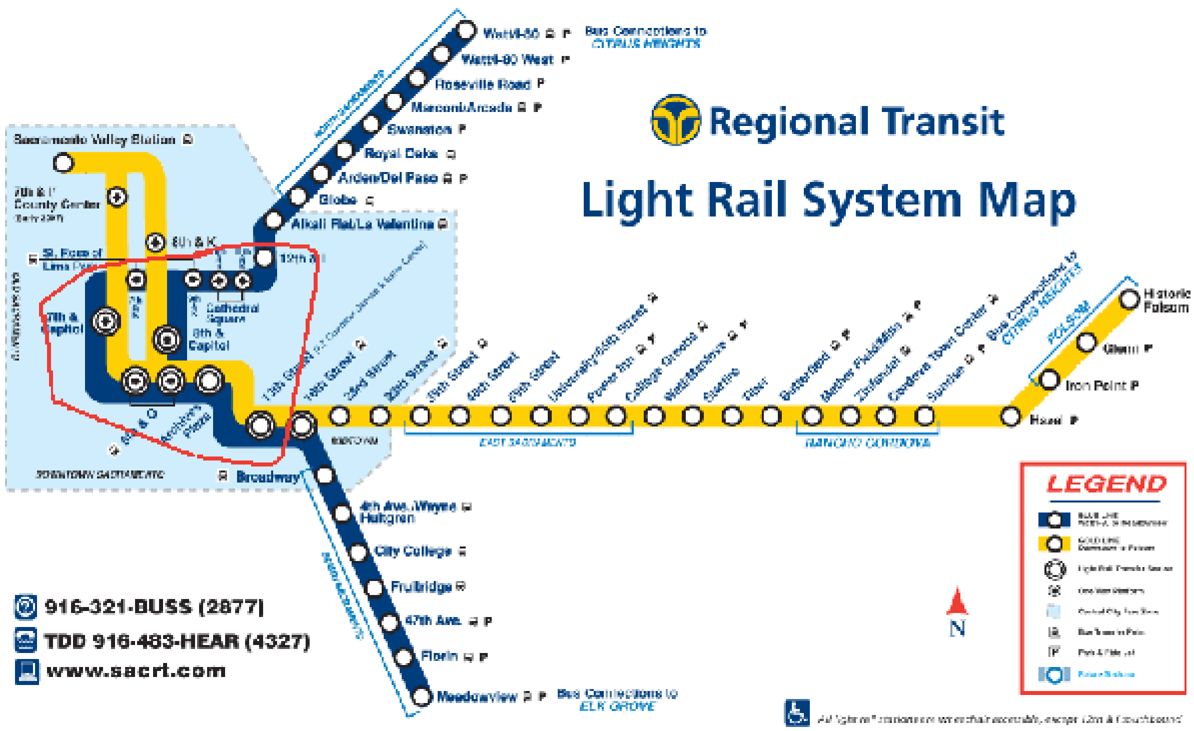


Figure 13 Sacramento LRT System: CBD versus non-CBD stations

The authors obtained afternoon peak-period passenger boarding data for the LRT in Dallas for 2006 that also allows us to differentiate between CBD (traditional) and non-CBD (non-traditional) riders. Traditional riders are those who board trains in the CBD during the afternoon peaks and make trips from the CBD to suburban residences. Non-traditional riders are passengers boarding at non-CBD stations during the afternoon peak period. Figure 14 shows the configuration of the two light rail lines and identifies the stations of both lines that serve the Dallas CBD. This examination shows that 43% of Red Line passengers boarded at non-CBD stations during the afternoon peak period, while 47% of Blue Line passengers boarded at non-CBD stations during the afternoon peak (see Table 13).

Table 12 RT Gold Line weekday a.m. peak alightings

Downtown Stations		Other Stations	
Station	**Alightings**	**Station**	**Alightings**
7th & I/8th & K	803	16th Streer–Transfer Station	751
7th/8th & Capitol	334	13th Street	101
8th & O Streets	580	23rd Street	149
Archives Plaza	565	29th Street	492
Sac Valley	195	39th Street	90
Subtotal	**2,477 (39.14%)**	48th Street	42
		59th Street	112
		65th Street	348
		Butterfield	280
		College Greens	152
		Cordova Town Center	59
		Glenn	54
		Hazel	37
		Historic Folsom	67
		Iron Point	67
		Mather Field/Mills	246
		Power Inn Road	201
		Starfire	37
		Sunrise	199
		Tiber	56
		Watt/Manlove	207
		Zinfandel	103
		Subtotal	**3,851 (60.86%)**
Total (Downtown and Other Stations)			**6,329 (100.00%)**

Table 13 Dallas (DART) LRT afternoon peak period boardings

Type of Boarding	Blue Line		Red Line	
	Number	**Percent**	**Number**	**Percent**
Passengers boarding in CBD	1,990	52.70	3,485	57.02
Passengers boarding on southern leg	1,258	33.32	999	16.34
Passengers boarding on northern leg	528	13.98	1,628	26.64
Total p.m. peak boarding passengers	3,776	100.00	6,112	100.00

Source: Complied from data provided by Gary Hufstedler, senior manager, Planning, Information and Analysis, DART, November 21, 2007.

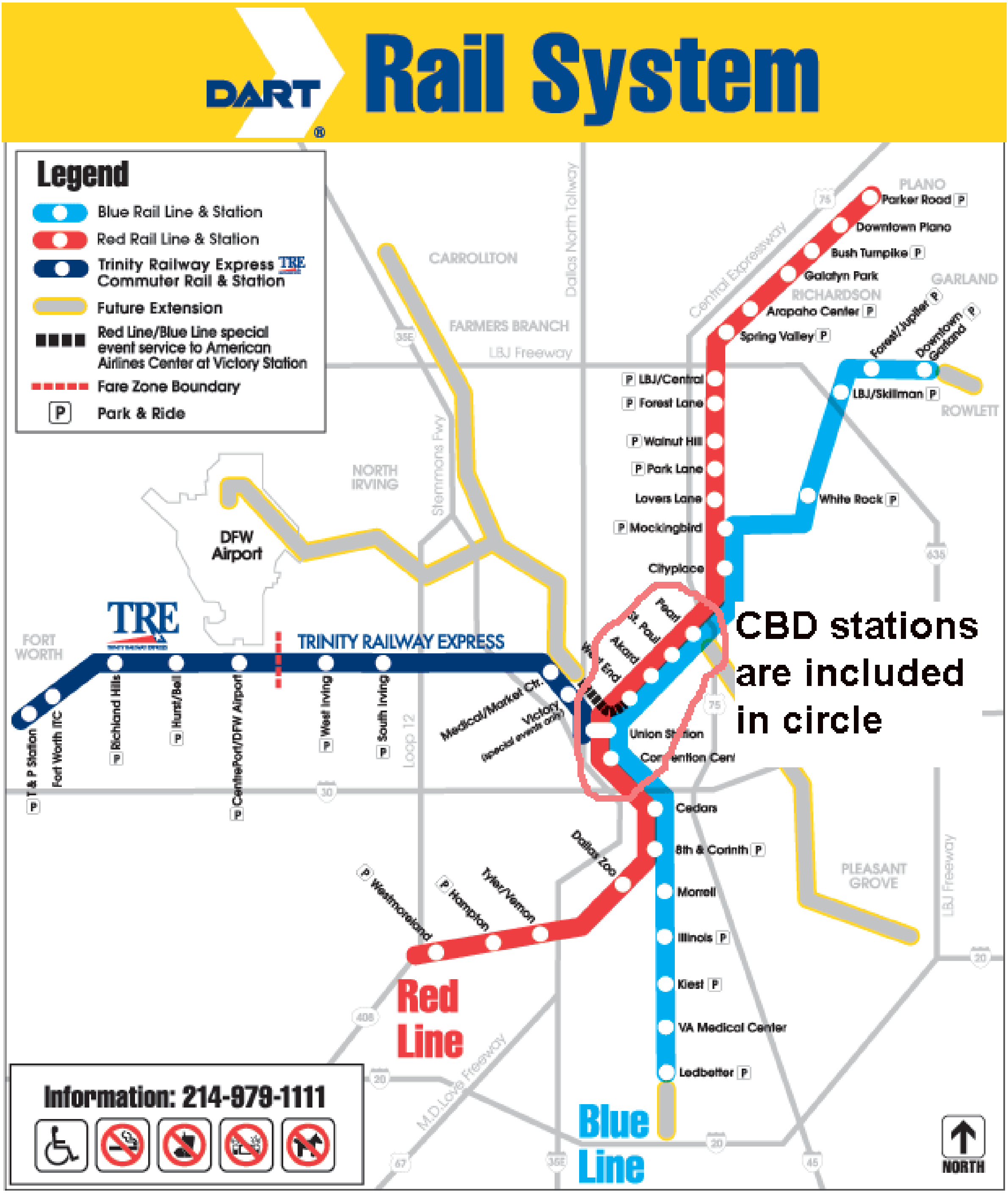


Figure 14 Dallas LRT system: CBD versus non-CBD stations

Clearly both lines are being used heavily by non-traditional passengers, but their usage patterns differ. The Red Line appears to serve more employment clusters (particularly in the suburbs north of Dallas) than does the Blue Line, and this attribute likely accounts for the larger number of boardings on its northern leg during the afternoon peak compared to the Blue Line. Both the Red and Blue Lines serve the poorer minority populations in the areas south of the Dallas CBD equally well, and they experience approximately the same number of boardings on their southern legs.

A final example of the importance of serving non-CBD destinations comes from Denver. Figure 15 presents a map of the LRT system and circles suburban stations in brown (southwest corridor) and black (southeast corridor) and circles the transfer station at I-25 and Broadway in gray. Table 14 summarizes the extent of usage of stations serving the job-rich Southeast LRT corridor, while Table 15 summarizes usage of stations serving primarily residential areas on the Southwest corridor of Denver RTD's light rail system. The usage is for an average January 2007 weekday morning peak period, which is defined as the period from 6:00 a.m. to 8:59 a.m. Both tables compare the strength of non-traditional patronage, composed of passengers destined to stations within these two suburban areas during the morning, with traditional passengers who begin their trips at suburban stations in the morning and travel outside of the two suburban areas, presumably to the CBD.

Table 14 reveals the existence of sizable non-traditional traffic that is destined during the morning peak to stations on the Southeast corridor, amounting to one third of the total morning peak boardings at Southeast corridor stations and stations outside of the Southeast corridor for passengers destined to the Southeast corridor. Somewhat more than half of this traffic is coming into the Southeast corridor from points north; somewhat less than half of this traffic is composed of patrons who both begin and end their rail journeys within the Southeast corridor. Not surprisingly, non-traditional traffic is less pronounced (but significant) on the Southwest corridor, that serves largely residential areas. Such traffic during the morning peak amounts to a little more than 20% of the morning boardings and alightings for Southwest corridor stations (see Table 15).

Some of the traffic that originates at stations within the two corridors during the morning peak and heads north is non-CBD related traffic, as well. A little more than 10% (796 trips) of this traffic alights at I-25 and Broadway, the first station beyond the point where the two corridors merge into a single trunk (see Figure 15). Some or all of these passengers presumably are destined to nearby destinations. Some passengers may transfer to southbound trains to reach more southerly destinations. More than 450 passengers board southbound trains at this station during the morning peak period.

In conclusion, the analysis indicates that non-CBD bound riders make up a sizable share of patronage on even CBD-focused transit services. Thus, serving non-CBD markets is even more critical than one might have initially expected. These non-CBD destinations represent the major destinations patrons wish to reach, and they are also the areas of growth in each metropolitan area. The CBDs, by contrast, are stagnant or in decline.

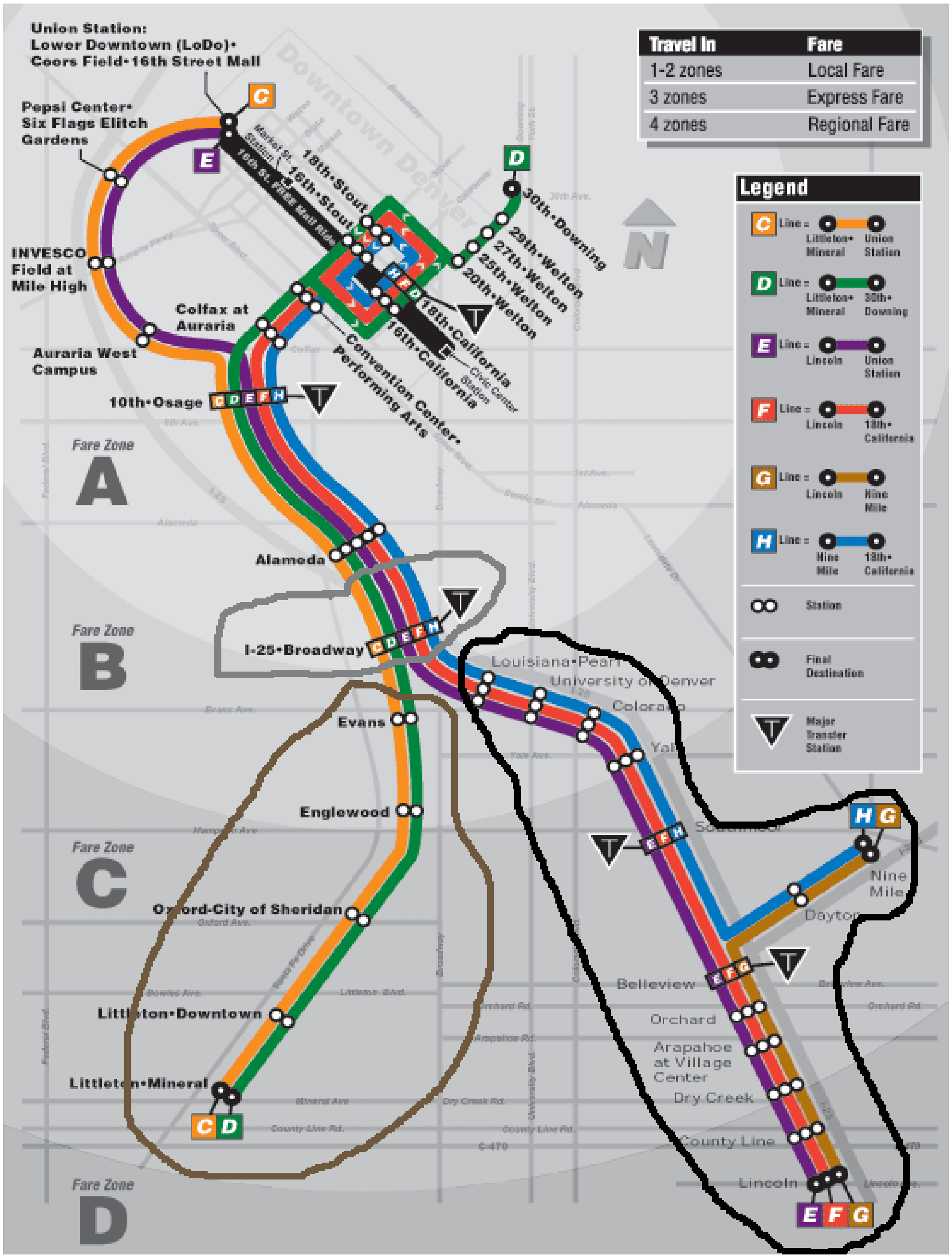


Figure 15 Denver LRT system versus non-CBD stations

Table 14 RTD Southeast Corridor light rail transit boardings

Type of Boarding	Number	Percent
Total boardings	**5,750**	**100.00**
Traditional riders (Southeast to North)	**3,817**	**66.38**
Non-traditional riders (all)	**1,933**	**33.62**
Southeast to Southeast, northbound	422	7.34
Southeast to Southeast, southbound	589	10.24
Boarded at other points (north), destined to southeast	922	16.03

Note: Table reports passengers boarding LRT during morning peak from Southeast corridor stations or who boarded outside Woutheast corridor but were destined to Southeast corridor status (including branch to Nine Mile).

Source: Rynerson 2007b.

Table 15 RTD Southwest Corridor light rail transit boardings

Type of Boarding	Number	Percent
Total boardings	**4,280**	**100.00**
Traditional riders (Southwest to North)	**3,380**	**78.97**
Non-traditional riders (all)	**900**	**21.03**
Southwest to Southwest, northbound	198	4.63
Southwest to Southwest, southbound	161	3.76
Boarded at other points (north), destined to southwest	541	12.64

Note: Table reports passengers boarding LRT during morning peak from Southwest corridor stations or who boarded outside Southwest corridor but were destined to Southwest corridor stations.

Source: Rynerson 2007b.

THE IMPORTANCE OF TRANSFERS

The use of transfers makes it possible for transit systems to serve a wider array of origins and destinations in dispersed metropolitan areas than can be served by one-seat-ride, point-to-point service. Successful transit systems take advantage of the potential for smooth transfers to broaden the array of potential destinations that their passengers can reach. They make it easy for their passengers to transfer by timing the connections to minimize wait time, and thus reducing the time penalty associated with transfers. They provide free transfer rights for their riders to reduce the financial penalty associated with transfers. Less successful transit systems do not do these things. They either attempt to avoid transfers by providing one-seat-ride service to a much smaller set of destinations, and/or they make it difficult and inconvenient for their riders who must transfer.

Transfer rates vary widely among the metropolitan areas that were studied (see Table 16). The highest transfer rates are found in Atlanta, Dallas, Denver, and Sacramento. Atlanta and Denver are two of the most successful cities included in this study. These two cities recognize the importance of transfers and work to facilitate easy transfer between bus-and-rail or from one bus route to another. Portland and San Diego also work to make transfers convenient for their passengers.

Table 16 Summary of transfer rates by mode for all MSAs

MSA	Transit Agency	Bus Percent	Rail Percent	System Percent
Atlanta	MARTA			95
Dallas	DART			54
Denver	RTD	55	45	
Miami	MTD	45	75	
Minneapolis	Metro Transit	48	72	
Pittsburgh	PAT			
Portland	Tri-Met	37	33	35
Sacramento	RT	64	54	60
Salt Lake City	UTA	64	54	35
San Diego	MTS			38
San José	VTA	37	40	

Source: Individual case studies in appendixes.

But perhaps the most striking thing the authors discovered about transfer rates is how low they are compared to what one would expect given the structures of the transit systems in each of the metropolitan areas and the available evidence about how passengers are using these systems. Their analysis indicates that transfer activity is being significantly undercounted, as the reported transfer rates do not correspond to the other information the agencies possess about their riders. They will discuss the importance of accurate transfer measurement in the following section of the guidebook. In the remainder of this section, they highlight the importance of transfers to successful transit systems focusing on the experiences of Portland, San Diego, and Minneapolis.

Portland reports relatively low transfer rates for its bus and rail services (see Table 16). However, these numbers stand in contrast with the transfer activity visible on the map shown in Figure 16. The map depicts average weekday boardings at Portland's light rail stations, and shows a complex pattern of usage reflecting the light rail system's function as the central part of a multidestination transit system. Stations serving the CBD stand out for their heavy usage, as do those in the formerly dying suburban mall, Lloyd Center, located across the river from the CBD.

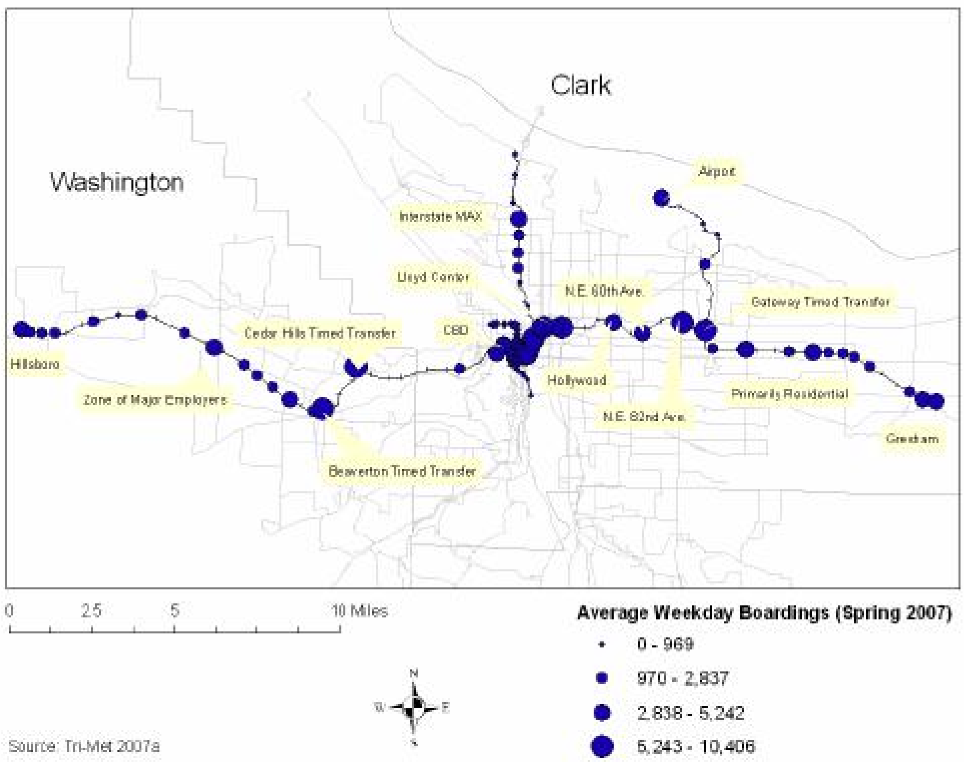


Figure 16 Evidence of transfer activity at Portland LRT stations in spring 2007

The next category of heavily-used stations includes those where city and suburban bus transfers occur. Cedar Hills and Beaverton on the west side stand out in this regard. Tri-Met implemented the Cedar Hills and Beaverton timed transfer centers in 1979 when it transformed the western part of its bus system from a radial to a timed transfer orientation. The reorientation greatly and permanently boosted the sector's transit patronage and changed its nature from a peak period, CBD-oriented patronage to an all-day, multi-destination patronage. When the light rail line was extended into that sector of the region twenty years later, it merely "plugged in" to the timed transfer bus centers that already were fully functional, replacing the bus connections between them and the Portland CBD. This history accounts for the high patronage at those stations.

Similarly, Tri-Met restructured its bus routes serving the inner east side in 1983. East-west routes serving the CBD were deemphasized; north-south crosstown routes were either fortified from hourly headways to 15 minute headways or started anew. Two of these north-south routes now are the most and second-most heavily-used bus routes in the Portland region. When the first light rail route opened in 1986, its east-west orientation cut across these north-south crosstown bus routes, and the patronage results are evident in Figure 16 at the N.E. 82nd Avenue, N.E. 60th Avenue, and Hollywood Stations. Slightly to the east of the N.E. 82nd Street Station is the Gateway Station. On the day that the first light rail line opened in 1986 all of the remaining east-west bus routes running from the CBD eastward were funneled into the Gateway Station. All of the long-distance suburban bus routes coming from the eastern part of the region also were funneled into the station. The patronage results are evident in Figure 16. Much of the activity shown on the map is thus a function of transfer activity at these stations.

San Diego is another city where transfers are an important component in the success of the multidestination transit system. The on-board transit survey shows that a relatively small part of the San Diego region's patronage transfers between transit vehicles (see Table 17). As with Portland, this survey finding does not comport with the other data obtained from the transit agency, where the transit stations of greatest activity, the transit lines of largest patronage and greatest growth, all are related to high levels of transfer activity.

Table 17 Access and egress methods used by San Diego transit riders

How did you get to this bus/trolley/Coaster? After you get off this bus/trolley/Coaster, will you ...?	Total Percent	Percent of Service						
		SDTC	NCTD	CVT	NCT	MTDB	SDTI	Coaster
Walk	54	63	58	54	49	55	43	23
Transfer	38	34	35	43	47	39	44	21
Drive alone	3	1	1	0	0	1	6	30
Drop off/carpool	4	2	4	3	2	3	6	13
Other	1	1	2	0	1	1	1	13

Source: SANDAG. *Results of the Onboard Transit Passenger Survey for the San Diego Region*, March 2004, 19.

Further evidence pointing to a high level of transfer activity in the San Diego area is contained in Table 18, which shows the 20 largest transit stops in the region in terms of week day usage in both before (2005) and after (2006) the Green Line LRT opened. The station with the highest use after the LRT opening is that at Old Town, a major transfer station between bus, light rail, and commuter rail. It also has a large park and ride lot, but the fact that usage in the station grew 50% in one year with the opening of the Green Line suggests heavy transfer movements. The second busiest station is at 12th and Imperial, which is where passengers transfer off the Blue Line LRT to head east on the Orange Line LRT, or they transfer off the Orange Line to head south on the Blue Line. Before the opening of the nearby ball park, there was little other reason for passengers to use this station. Roughly 30% (3,557 passengers) of the passengers on board trains coming from the south on the Blue Line alight at the 12th and Imperial Station each day. Each day approximately 2,800 passengers board outbound Orange Line trains heading east from the 12th and Imperial Avenue Station.

Table 18 San Diego top 20 transit stops in fiscal year 2005 and fiscal year 2005

Stop	FY 2005 Rank	FY 2006 Rank	FY 2005 Trip Ends	FY 2006 Trip Ends	Percent Change 2005–2006
Old Town Transit Center	2	1	20,574	31,958	55.33
12th and Imperial Station	1	2	20,639	21,858	5.91
International Border Station	3	3	19,849	20,949	5.54
Iris Avenue Trolley Station	4	4	14,977	15,431	3.03
H Street Trolley Station	5	5	11,972	12,210	1.99
5th Avenue Station–C Street	6	6	11,034	11,182	1.34
El Cajon Transit Center	11	7	8,799	10,935	24.28
Euclid Trolley Station	7	8	10,381	10,622	2.32
City College Station	8	9	10,243	10,565	3.14
Fashion Valley Trolley Station	10	10	9,347	10,072	7.75
Palomar Street Trolley Station	9	11	9,988	9,483	-5.06
Civic Center Station	12	12	8,351	7,644	-8.47
24th Street Trolley Station	14	13	7,656	7,583	-0.95
American Plaza	13	14	7,938	7,170	-9.67
Escondido Transit Center	16	15	6,629	7,157	7.97
San Diego State University	36	16	2,281	6,968	205.48
Vista Transit Center	15	17	6,747	6,794	0.70
Park and Market Station	21	18	5,618	6,106	8.69
E Street Bayfront Trolley Station	17	19	6,397	5,959	-6.85
Ocenside Transit Center	18	20	6,162	5,546	-10.00

Source: San Diego Association of Governments (SANDAG), "Fiscal Year 2006 Weekday System Ridership Profile," from *Assistance to Transit Operations and Planning, Fiscal Year 2006*, www.sandag.org/uploads/publicationi, accessed November 28, 2007.

Other important bus-rail and bus-bus transfer stations include H Street Chula Vista, Iris Avenue, the El Cajon Transit Center, the SDSU (San Diego State University) Trolley Station, the Euclid Trolley Station, the Fashion Valley Trolley Station, the Escondido Transit Center, the Vista Transit Center, and the Oceanside Transit Center. Some of these stations, such as Fashion Valley Trolley Station and SDSU, are important destinations in their own right, but in addition, transferring also takes place. Others are primarily locations of transfer movements. Most of them are rail/bus stations. Only the Vista and Escondido Transit Centers were bus only in 2006, but even these stations became bus/rail stations with the opening of the Sprinter diesel light rail service on March 9, 2008. The location of these stations is shown in Figure 11 shown earlier, which unfortunately shows passenger boardings in 2005 before the Green Line opened. The strategic importance of the stations in connecting a collection of routes into a regional network is evident in this map.

A final indication of the importance of transfer activity comes from Minneapolis-Saint Paul. Table 17 reported a 72% transfer rate for passengers on the Hiawatha LRT line, which serves as the backbone for the transit system in its corridor of the metropolitan area. Figure 17 maps average weekday boardings in 2006 by station. The large circles in the center of the alignment correspond to transfer points with major crosstown bus routes.

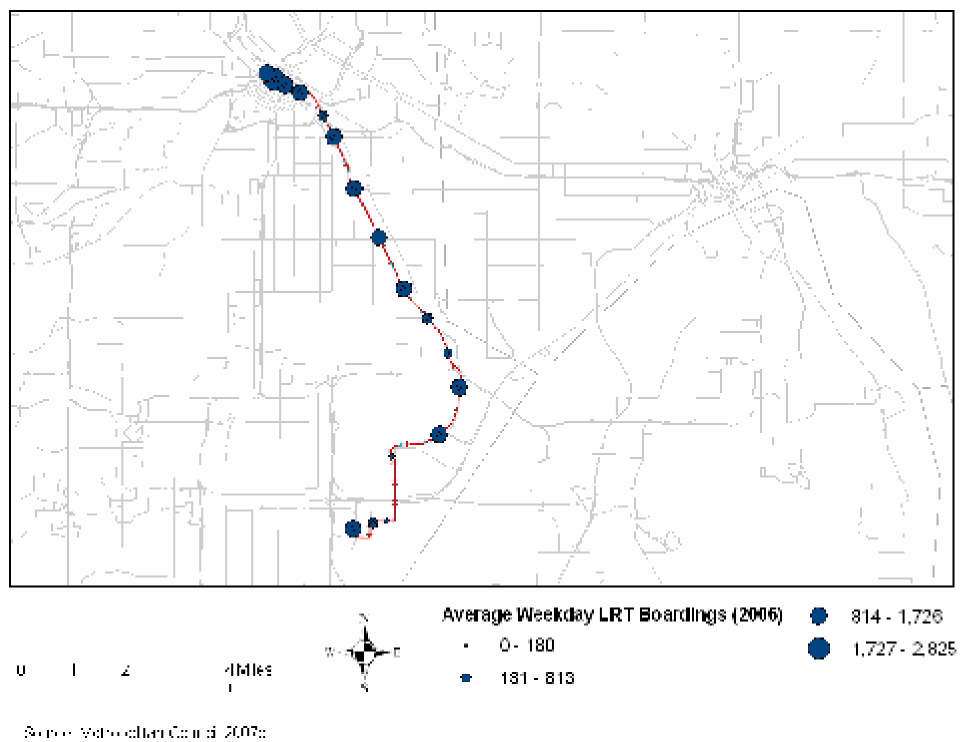


Figure 17 Evidence of transfer activity at Minneapolis LRT stations in 2006

The analysis indicates that transfers are an important component in rail transit success because they extend the reach of the transit system to serve a wider array of destinations. This, in turn, makes the transit system more attractive to potential riders. Successful transit systems work to make transfers as convenient as possible for their riders, while less successful ones do not.

THE IMPORTANCE OF ACCURATE TRANSFER MEASUREMENT

As noted above, the transfer rates reported for the case study metropolitan areas, which are usually derived from on-board surveys of transit riders, are much lower than one would expect given the structure of the transit systems and the large observed transfer movements in cities like Portland and San Diego discussed above. Having accurate information about transfer activity is important because such information is used to make service and fare policy decisions. Inaccurate information suggesting very low transfer rates may lead an agency to make service and fare decisions that downplay the importance of transfers, or make it more difficult for riders to transfer, with potentially serious negative consequences for ridership and productivity.

For one of the case study metropolitan areas, Atlanta, the authors obtained data on transfer activity for the area's primary transit agency, Metropolitan Atlanta Rapid Transit Authority (MARTA). The data come from two different sources, each leading to a different conclusion about the importance of transfers. The source based on on-board passenger surveys leads to the conclusion of a low transfer rate. The source based on surveys of fare media leads to a conclusion of high transfer rates. In this section the authors compare those two sources and conclude that the method showing higher transfer activity is the more internally consistent method of the two. The implication is that in other regions of the country where only the on-board survey method is available, transfer rates are under reported.

Two sources of transfer data are available for MARTA's services, one from MARTA itself, and one from the Atlanta Regional Commission (ARC). Interestingly, ARC and MARTA have very different estimates of the amount of transfer activity that is taking place on the MARTA system. The authors also calculated their own estimates of MARTA's transfer rate, using data supplied by MARTA and data obtained from the National Transit Database. The authors will discuss this estimate of transfer activity first.

The authors' definition of transferring is: the number of transfers that take place in a transit system in a year divided by the number of annual transit patrons. One transit patron is a person who completes a trip on transit, regardless of how many times they transfer. The resulting percentage indicates, on average, the percent of patrons who transfer.

It is possible to calculate the transfer rate with the following formula:

Transfer Rate = (unlinked passenger trips - linked passenger trips)/linked passenger trips

To illustrate the above formula, consider the following example. Suppose three different individuals boarded a bus (three unlinked passenger trips), and then two of them transferred to another bus to complete their trip (two additional unlinked passenger trips). Thus, there are three individuals making three linked trips but making a total of five transit vehicle boardings (unlinked passenger trips). The formula indicates a transfer rate of about 67%.

Using this formula, the authors calculated a history of MARTA transfer rates (see Table 19). Transfer rates of about 30% in the early 1970s are typical of a transit system of the time with a largely radial route structure focused on the CBD. However, as MARTA opened rail lines and truncated bus routes at rail stations, the number of transit patrons who transferred increased dramatically in several steps: 1981 (34% to 69%), 1983 (83% to 101%), and 1984 (101% to 125%). The transfer rate has fluctuated between about 99% and 130% since that time. In the late 1980s the rising rate of transferring undoubtedly reflected "forced transfers," in other words, patrons who previously had a one-seat bus ride from the suburbs to the CBD suddenly being forced to transfer from a feeder bus to a rail line, and perhaps having to transfer a second time from the rail line to their final destination in the CBD. Over time, however, MARTA patrons increasingly have been using the transfer opportunities to reach major destinations that increasingly are appearing in the suburbs, destinations that they would have been unable to reach with a radial bus system.

Table 19 Author-calculated MARTA transfer rate (1972–2003)

Year	Percent Transfer Rate	Year	Percent Transfer Rate
1972	30.16	1988	106.02
1973	28.01	1989	103.12
1974	28.31	1990	99.50
1975	28.12	1991	104.85
1976	30.00	1992	107.38
1977	32.17	1993	113.62
1978	29.73	1994	113.97
1979	31.69	1995	113.92
1980	34.35	1996	114.93
1981	68.56	1997	117.44
1982	83.07	1998	109.77
1983	101.47	1999	110.84
1984	125.14	2000	114.37
1985	123.23	2001	113.42
1986	98.79	2002	130.99
1987	98.84	2003	117.84

Sources: Florida Department of Transportation 2006; Metropolitan Atlanta Rapid Transit Authority 2006a.

How does the authors' estimate of transfer activity compare with MARTA's most recent on-board survey? Table 20 indicates that in 2006 about 36% of MARTA's patrons did not transfer at all, about 37% transferred once, and about 23% transferred more than once. Overall, Table 20 indicates 1.95 unlinked trips for every linked trip, or an overall transfer rate of 95% according to this method. These results are roughly compatible with those in Table 19 above.

Table 20 Breakdown of MARTA linked trips

Number of Unlinked Trips	Percent of Patrons Making This Number of Unlinked Trips to Complete Their Journey
1	36.20
2	37.60
3	21.20
4	5.00
5	0.10

Source: MARTA Transit Research & Analysis, "Systemwide Factors and Free Intermodal Analysis for National Transit Database Reporting for Fiscal Year 2006," August 2006, 18.

The Atlanta Regional Commission, on the other hand, estimates a transfer rate from their own on-board passenger survey conducted in 2002 pursuant to Transit Cooperative Research

Program standards, and their method indicates a much lower rate of transferring, in the range of 20%. The final report for the survey concludes:

> Most passengers are able to get to their final destination by not having to transfer from or to another bus or train. Convenience of being able to get to their final destination is usually cited as a reason for using public transit and if a transit system is able to minimize the need for passenger transfers the better off the passenger is. However, the major challenge is for the transit system to efficiently (both in operating and in geographic coverage) provide service. Overall, during the week and weekend, nearly six-in-ten sampled passengers access public transit by walking. Bus access is dominated by walk mode. By nature of the rail system (and its use by commuters), nearly one-in-three access MARTA's rail system by driving a car and parking. Overall, nearly two-in-ten accessed their sampled bus trip by transferring from another bus or MARTA rail. Nearly 80 percent of passengers can get to their final destination by not having to transfer to another bus or the rail system. Slightly more than six-in-ten can get to their final destination by walking.[95]

The authors of this study contacted ARC's Modeling Manager, Guy Rosseau to ask about the discrepancy in transfer rates based on MARTA and ARC methods.[96] After examining the evidence, Mr. Rosseau concluded that the conclusion in the 2002 ARC report of survey results is in error and was based on examining the question of how many passengers in a bus or train accessed that bus or train from another bus or train. It did not consider how passengers might egress the bus or train. Recalculating the figures in the ARC on-board survey, Mr. Rosseau concluded that 39.18% of MARTA unlinked trips transfer at least once. He added that there is no way of telling from the survey the extent of multiple transferring.

Using the equation presented above, the authors recalculated the figures that Mr. Rosseau provided us to arrive at the percentage of the MARTA patrons (linked trips) who transfer at least once and arrived at a figure of 64%. Given that 38% of MARTA's patrons who transfer do so more than once, the figure of 64% of linked trips transferring at least once is consistent with an overall transfer rate of about 90%. The 90% figure is less than what the history of the relation of linked and unlinked trips indicates, but it is much closer to that figure than the conclusion in the ARC final report for the 2002 onboard survey. Overall, the authors conclude that MARTA experiences approximately one transfer for every patron who uses the system.

If the experience of Atlanta and MARTA are typical, which the authors suspect is the case, then transfer rates are being consistently underreported for transit agencies throughout the U.S. This is a serious issue because inaccurate information may lead agencies to reconfigure their route networks, eliminate transfer points, and eliminate free transfer privileges, if they exist. Such decisions could have a serious negative effect on ridership and productivity. More attention needs to be paid to this neglected issue.

TWO CAUTIONARY TALES: RAIL ALONE IS NOT ENOUGH TO GUARANTEE SUCCESS

The most successful transit systems take a comprehensive approach to rail transit planning that focuses on providing passengers with easy access to the rail service, often through an array of modes. The service is located in a corridor (or in multiple corridors) that allow rail transit, directly and using its bus connections, to link the major activity centers to which patrons wish to travel. This is the case with successful rail transit systems in Portland, San Diego, and Atlanta.

The authors' analysis shows that simply placing rail transit in corridors that are collocated with major activity centers is not sufficient to guarantee ridership success. It is necessary to carefully plan how riders will access and egress the rail transit system and then reach their final destination. It is also important to provide high-speed, high-frequency service. The analysis also shows that using rail transit as an economic redevelopment tool may result in lower-than-anticipated ridership when the development fails to materialize.

Two case studies illustrate the importance of these lessons. The first case study of Miami highlights the limitations of rail transit as an economic development tool. The second case study of San José highlights the often-overlooked issues of access and speed in contributing to rail transit success. The authors discuss each of these lessons in turn.

Lesson #1 Rail doesn't always have the Midas touch.

There is a widely-held belief by many policymakers and rail transit advocates that rail transit investment can be used to spur redevelopment in depressed communities. Paraphrasing former Dallas Mayor Ron Kirk, rail transit is presumed to have the Midas touch; it can literally turn depressed communities into economically vibrant ones simply by the fact of its presence. Such a belief underlies planning decisions about rail alignments in many cities. One of these cities is Miami.

Miami Metro Rail ridership has been a target of many rail critics. These critics point to the forecast of 200,000 passengers per day used when the plan was presented to the public versus the actual 45,000 to 50,000 passengers per day on the current system. The study's interviewees emphasized that the forecast figure was for a more extensive system than was actually built, and that the actual ridership numbers correspond pretty well with the forecasted numbers for the two segments that were built. The authors obtained data on average weekday boardings (by station) for Metro Rail in 2007 (see Figure 18). The most striking thing about the map is the fact that the busiest stations are located in the Miami CBD and along the southern segment of the line. There is relatively little boarding activity in the northern portion of the system. Why is this the case?

According to the Miami interviewees, the objective of rail development was to improve mobility and to stimulate development around rail stations. However, subsequent policy decisions have hindered rail transit. The first important political decision was to develop only two of the originally proposed seven rail corridors, only one of which had significant ridership potential. Miami Beach residents opposed the development of elevated rail in their city. This removed the highest ridership corridor from the plan. Other community objections and local political considerations also affected the alignment. Community objections in Coral Gables led to only the station at the University of Miami being provided in this potentially high ridership corridor.

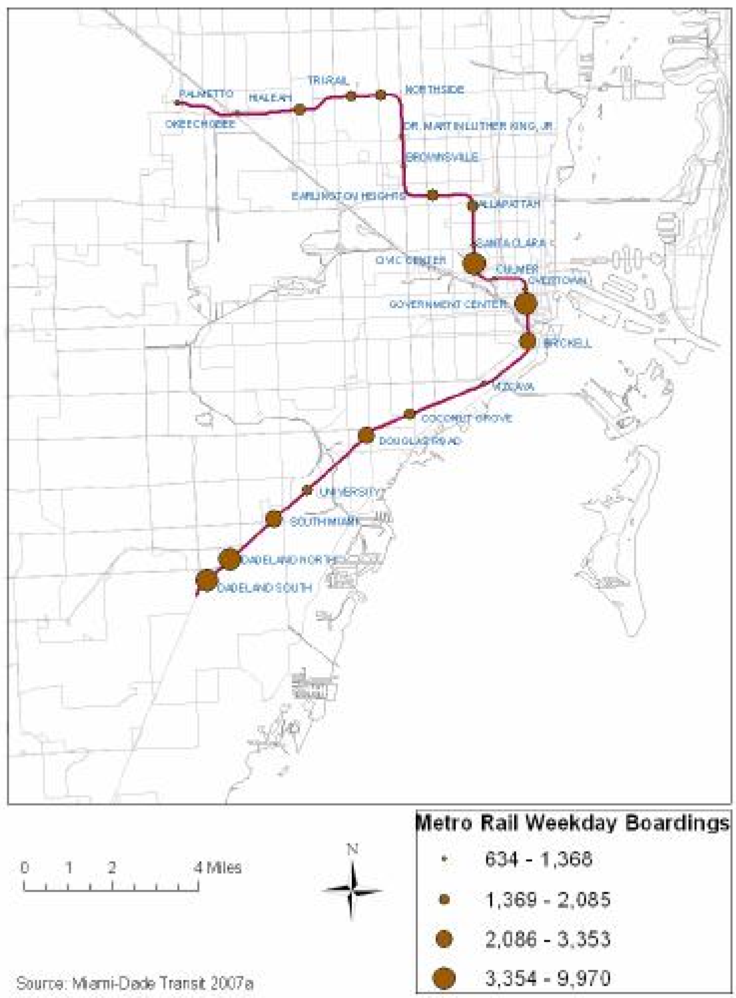


Figure 18 Average weekday metro rail boardings in Miami in 2007

The second important political decision was to use the rail transit investment as a means of stimulating development in a corridor that lacked ridership potential. According to the authors' Miami interviewees, the decision to locate stations here was part of a political strategy to use transit as an economic revitalization catalyst in a very depressed area. Unfortunately, the hoped-for development (and associated ridership) has still not materialized in this corridor. Some station boardings in the northern portion of the Metro Rail alignment are only 10% of the initial forecast. Rail transit has not had the Midas touch.

Lesson #2 Access and speed are critical to rail transit success.

The experience of San José demonstrates that even placing rail transit in the right places is not sufficient to guarantee its success. The alignment of the LRT follows, at least roughly, the patterns of population and employment in the San José area. The north-south trunk line and the southwestern leg of the LRT are both located in close proximity to major employment centers. The southeast leg is located in close proximity to major residential concentrations. The northwest line is also located near major employment centers, although the LRT follows a circuitous path to reach Mountain View. The east side line serves a populous corridor as well as a large regional mall. So, on balance, LRT appears to have been placed in many of the right kinds of corridors. However, Figure 19 shows that station boardings are modest at best. Why is the LRT ridership so poor?

First, rail needs to be faster than the buses it replaces in order to be attractive to patrons. Essentially, LRT (with stops) should approximate the speed of a non-stop express bus. Unfortunately, the LRT is plagued by slow speeds. The State of California's Public Utilities Commission (PUC) permits only a 10-mph maximum speed on the downtown Transit Mall unless safety-related infrastructure is provided. Adding this infrastructure would require reconstruction of the mall, which the city of San José has opposed. So, the light rail line has to live with the very slow speed through the downtown, which requires trains to consume 12 minutes on the Guadalupe Line and 17 minutes on the Vasona Line to negotiate. Circuitous routing adds to travel times on the northwest leg as well.

Second, VTA has low-quality bus service. Most bus routes have long, irregular headways, which make it difficult to devise timed connections with LRT. Long and irregular headways make the task for bus passengers of transferring between bus routes onerous. Passengers transferring between buses and trains and from trains to buses also face unpredictable and often lengthy waits, adding to both anxiety and inconvenience. The integration of bus and rail service is thus impeded. Buses should operate to complement LRT, and vice versa, but the poor quality of bus service makes this hard to achieve in San José. In other study areas, buses act as feeders to LRT and LRT feeds buses, thereby improving the productivity of both modes.

In addition, buses do not connect sizable parts of the residential districts of Santa Clara County with the light rail line spine, which, if they did so, could function as a distributor to a large number of jobs. It is as though the ribs have been broken off the spine and lie more or less parallel to it. This quality is particularly pronounced for the populous west side of the valley, north of the CBD. Just to the east of this area runs the north-south Guadalupe Corridor light rail line with stations at major employers. It would be a natural for east-west buses to run through the populous areas west of the Guadalupe Corridor before intersecting with it. If they did, bus passengers could change to trains to access jobs both north and south. By and large, such connections are missing.

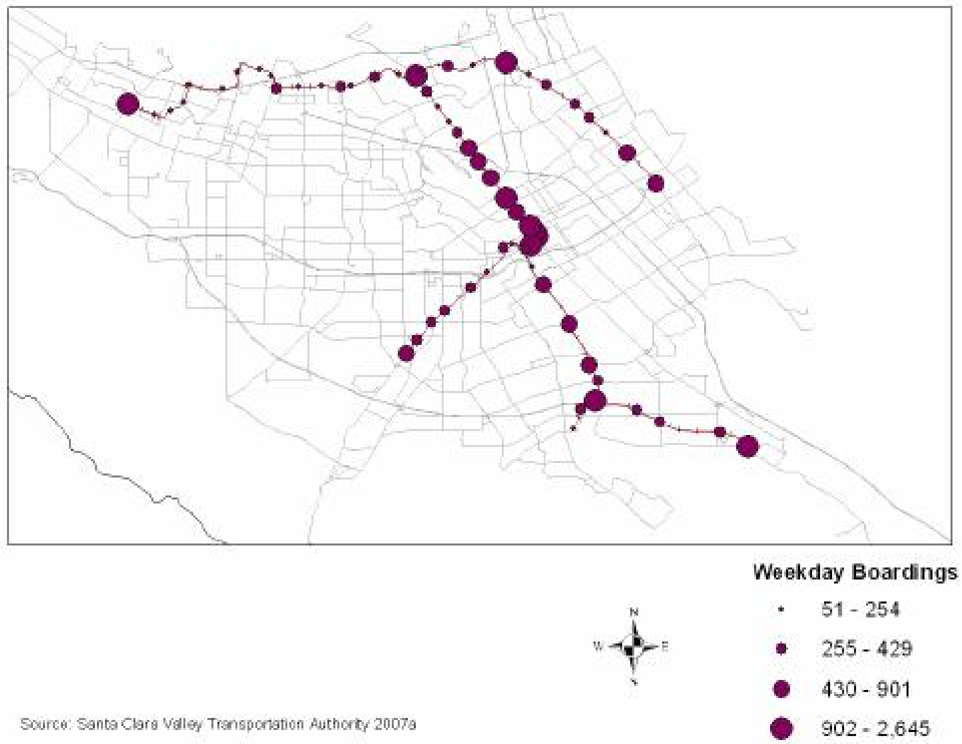


Figure 19 Average weekday light rail boardings in San José in 2007

Third, the LRT suffers from access problems in many portions of the alignment. The LRT's placement in a freeway median poses serious access challenges to LRT patrons accessing the line as pedestrians or bus riders, or for LRT patrons wishing to depart the LRT to make bus transfers or access final destinations. The bus-rail interface is awkward. Buses stop at parking lots, and not on the overpasses. This means that buses must lose precious minutes as they turn off the arterial roads at congested intersections and then thread their way around circuitous one-way loops within the lots. Once they finally reach their stopping place, they still are far removed from the rail platforms. Bus passengers alight, then walk across parking lots, climb up long flights of stairs to reach a pedestrian crossing that spans the freeway, cross to the middle of the freeway over the din of hundreds of cars and trucks speeding underneath at 60- to 70-mph, and then climb down other long flights of stairs to access the LRT, wedged onto an island amidst the roaring traffic. The difficulty and unpleasantness of accessing the LRT in such a repellant setting, combined with the modal competition provided by the presence of the freeway, may partially explain lower than expected LRT ridership.

THE IMPORTANCE OF SERVING REGIONAL DESTINATIONS

One of the most important lessons from the case studies is that successful transit systems seek to serve all of the region's major activity centers. These activity centers represent the destinations to which people wish to travel, and failure to serve these centers with high-quality service places transit at a competitive disadvantage versus the automobile. In metropolitan areas where significant activity centers are not served, the result has been diminished riding habit and productivity. In order to illustrate the link between transit system structure and the pattern of activity centers in each metropolitan area, the authors reproduced the employment density maps contained in each of the case studies. Using these maps, which place the regional transit system atop the regional employment pattern, this study highlights the cities where the region is being adequately served and the places where they are not.

One of the most successful cities in the study is San Diego. Earlier in the guidebook is a discussion of the original service concept for San Diego (shown in Figure 5). This concept found expression through development of an integrated bus-LRT network that emphasized improved productivity at lowest possible cost and connecting transit to a larger number of destinations throughout the region. Since advent of LRT in 1981, evolution of both transit system and its usage has validated this vision. San Diego has maintained strong and stable productivity while increasing riding habit substantially. San Diego has adapted its transit system to better fit its dispersed pattern of travel destinations. Figure 20 displays the San Diego transit system atop the pattern on employment in 2000. (Employment is density by census tract.) The map clearly shows that San Diego has served the major activity centers in the region, and this fact helps to explain the region's strong transit performance. In many respects, San Diego is a model of how to successfully integrate bus and rail services.

But there are some areas of concern. There is a mismatch between the geographic areas of LRT investment and those of employment growth. San Diego pursued an express bus strategy in major employment corridors, such as I-5 and I-15. These services have not generated high ridership, although they serve corridors with large numbers of jobs and moderately dense residential developments. The Regional Concept Element sought to cover the region with an overlay of high-speed regional routes. As noted earlier, some of these routes were subsequently developed as LRT and others as express buses. The authors' analysis indicated that the LRT corridors were significantly more successful at generating ridership than their express bus counterparts.

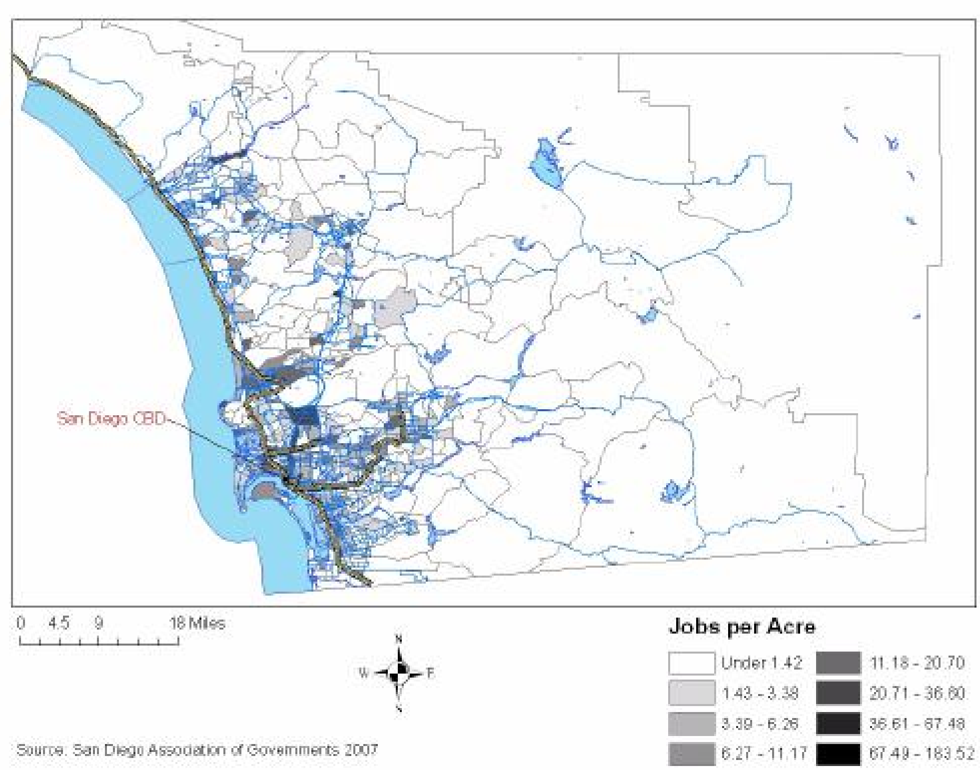


Figure 20 Regional destinations and transit system in San Diego, California

A city even more successful than San Diego is Portland. Portland ranks highest among the eleven cities in riding habit and second (to Atlanta) in productivity. Figure 21 indicates that Portland's bus-rail transit system grid serves all the major activity centers on the Oregon side of the Columbia River. It does so with high-quality, frequent service on a regional network in which bus and rail services are integrated and transfers are seamless. Portland's LRT system was itself planned in a way that it tapped the rapidly growing suburban corridor in the western part of the metropolitan area. These qualities help to explain the region's transit success. Portland will be discussed in more detail in the final section of the guidebook.

Another city that has achieved high riding habit success, although one that suffers from some productivity issues, is Denver. Unlike most of the study cities, the Denver area has a single agency that provides transit service: Denver RTD. This agency has developed a regional vision and implemented a service structure to achieve this vision. Denver possesses a truly regional transit system with a veneer of regional service, although its regional services are not presently the kinds of high-speed, high-frequency services needed to provide strong regional connectivity.

Figure 22 indicates that Denver's regional transit system matches the pattern of regional activity centers. As with Portland, Denver has introduced LRT in a rapidly growing corridor; in Denver's case it is the corridor to the southeast of the Denver CBD. Both of these factors explain Denver's strong riding habit. Its low productivity is the result of service planning decisions related to duplicative LRT service and bus route deviations, both of which are designed to reduce the need for transfers. The authors discuss these issues in more detail in the Denver case study.

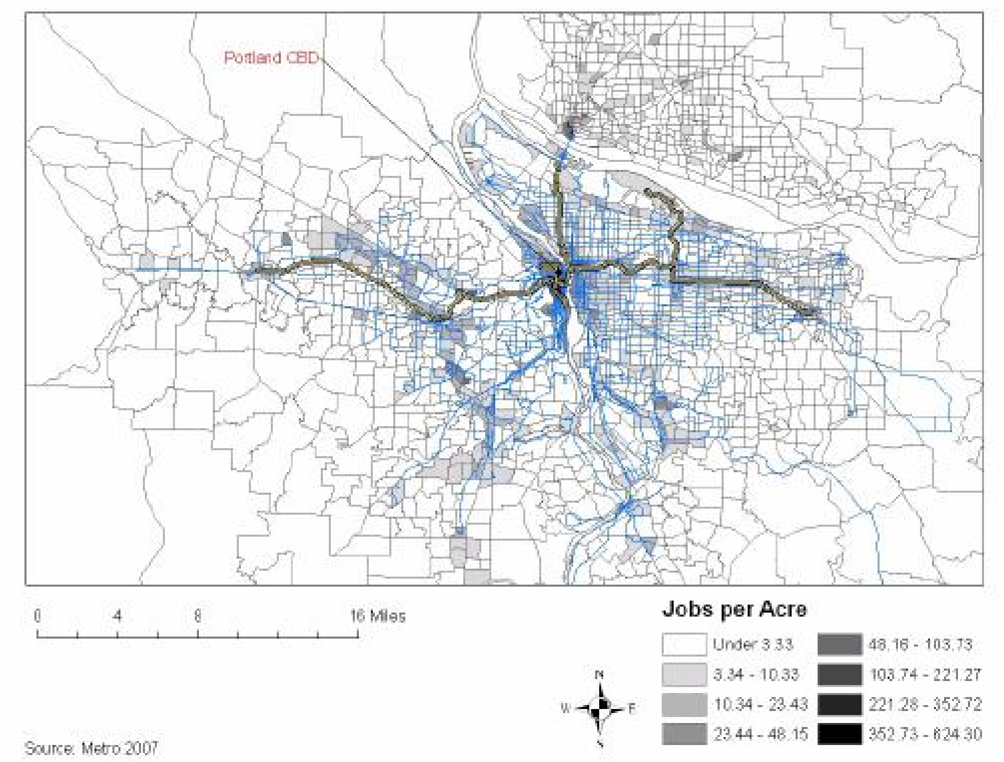


Figure 21 Regional destinations and transit system in Portland

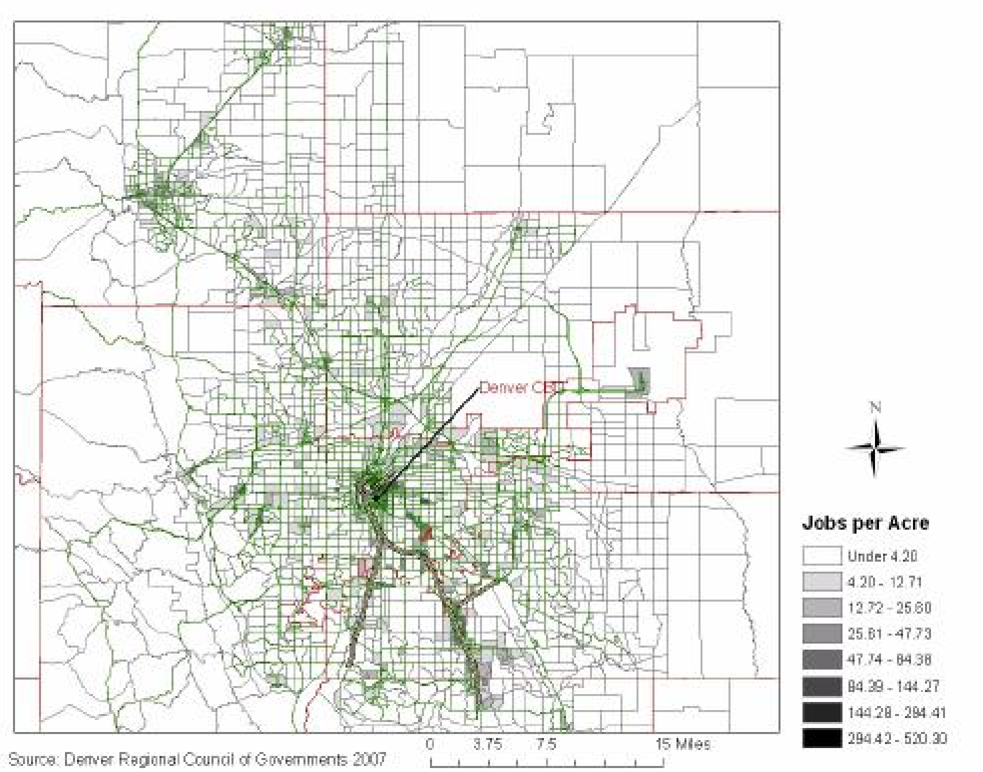


Figure 22 Regional destinations and transit system in Denver

The authors' analysis of Atlanta suggests a transit system in transition, as the region struggles with the development of a regional transit vision. At present, there are two distinct service visions with very different ridership results. Inside the region's core of Fulton and DeKalb Counties, MARTA has articulated and implemented a multidestination service version that serves a diverse array of travel destinations (see Figure 23). MARTA has coordinated and integrated its bus and rail services, using the extensive bus network as a distribution system for its rail transit system, which serves as a trunk line. The analysis indicates that this service strategy is working. MARTA enjoys high ridership and high service productivity. MARTA is successfully serving the growing non-CBD travel markets that are most important in this still-decentralizing region.

Outside the MARTA service area, there is a very different vision, and a very different service strategy. Individual transit agencies, informed by erroneous data on transfer rates and other aspects of travel behavior, have implemented service strategies focused on feeding people into the center of Atlanta, in the peak direction only. The services provided by GRTA, CCT, and GCT are not well coordinated with one another, or with MARTA's bus services. The lack of service coordination, and the neglect of travel destinations outside the center of Atlanta, has resulted in poor ridership and low productivity on these systems. The miniscule ridership on GRTA express buses is particularly striking.

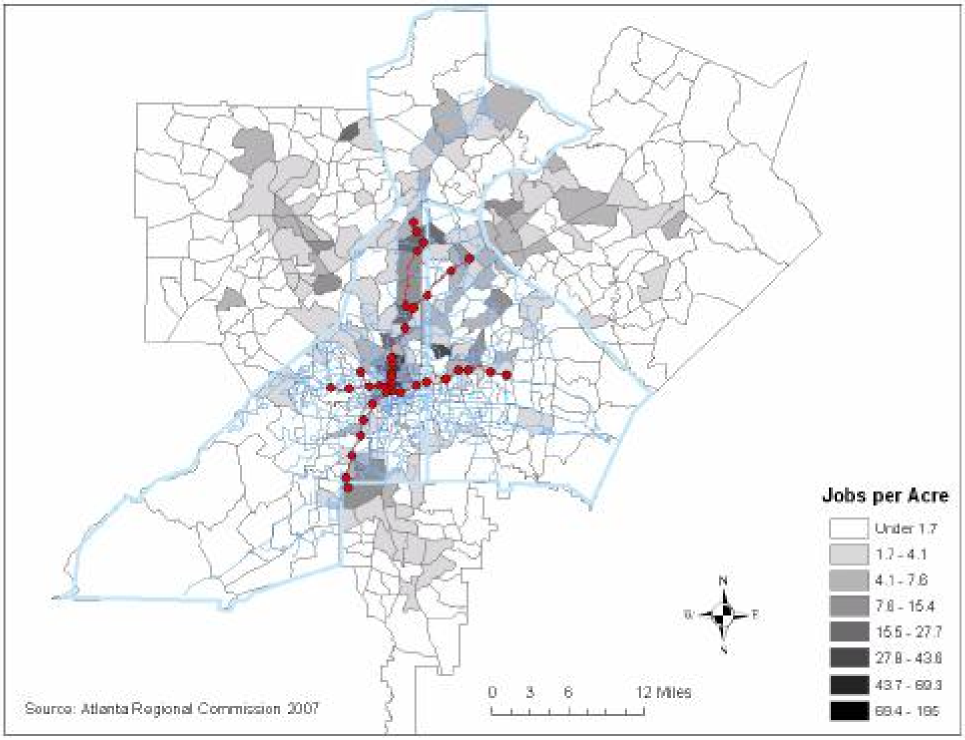


Figure 23 Regional destinations and and present MARTA transit system in Atlanta

The authors' analysis suggests that the vision and service strategy being pursued outside the MARTA service area has not and will not generate significant ridership. The Atlanta metropolitan area is increasingly decentralized, and the center of Atlanta represents a diminishing share of the region's travel destinations. Every year, fewer Atlantans travel into the regional center for employment and other purposes every year, while more Atlantans seek to travel to other major activity centers outside the center. An effective regional service strategy would seek to serve the growing travel markets, as opposed to focusing solely on serving the declining one. An effective regional service strategy would extend the vision and service strategy being implemented by MARTA, inside its service area, to the metropolitan area as a whole.

Given the region's ever-increasing size and complexity, the authors believe that an overlay regional transit system is required to serve the increasing number of long-distance trips. This system would feature an inter-connected grid of routes with stations at all major destinations. A model for this type of system would be the RER in Paris or the S-Bahn in various German cities. Such a system might include regional rail (not focused predominantly on the Atlanta CBD), MARTA rail, and bus rapid transit services (not implemented as part of major freeway projects).

Figure 24 maps how such a system might be devised, while leveraging the existing MARTA bus and rail system to form its core. On top of Figure 23, the authors have sketched (bold line) a handful of high-speed regional routes that could serve as the framework for extending MARTA's multidestination strategy to a larger area. The map shows that such a strategy is not an overwhelmingly difficult one, as most employment concentrations are located in corridors as opposed to being widely dispersed. As new employment corridors emerge, new segments can be added to the regional system. These regional routes would coordinate with local services in each of the corridors.

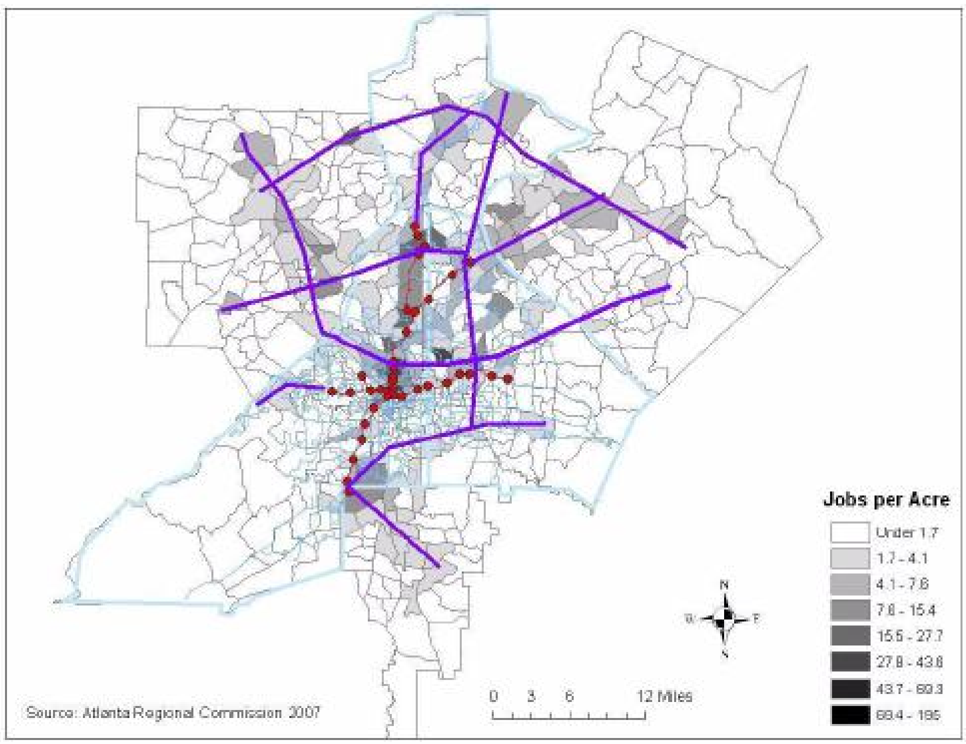


Figure 24 Regional destinations and present MARTA transit system in Atlanta

Another metropolitan area that lacks truly regional service is Dallas-Fort Worth. Figure 25 plots the present Dallas area transit system on top of the pattern of regional employment. From this map it is clear that the DART part of the region has a transit system that serves the major destinations, while the rest of the region lacks important elements in its transit system. Overall, the authors sense that the Dallas region lacks three things that are seen as key for regional transit success. First, transit does not serve the major employment centers in the Arlington area. Second, the region lacks a multidestination focus outside the DART service area. Other transit operators, most notably the T, focus on a CBD market, and this has led to declining ridership as the region continues to decentralize.

Finally, the Dallas area lacks an inter-connected network of high-speed regional transit services that link all the region's major activity centers. Such a system could be constructed from a combination of regional rail and bus rapid transit services, and could include TRE as one of its components. It might also include LRT if the service was capable of relatively high speeds. This regional system would be super-imposed over the existing transit networks. A high-speed system is necessary to make transit competitive, given the long trips that would result in this decentralized metropolitan area. Existing express bus services to the Dallas CBD are not useful in this regard. This hypothetical regional system represents the logical extension of successful ideas being used by DART inside its service area to the entire region.

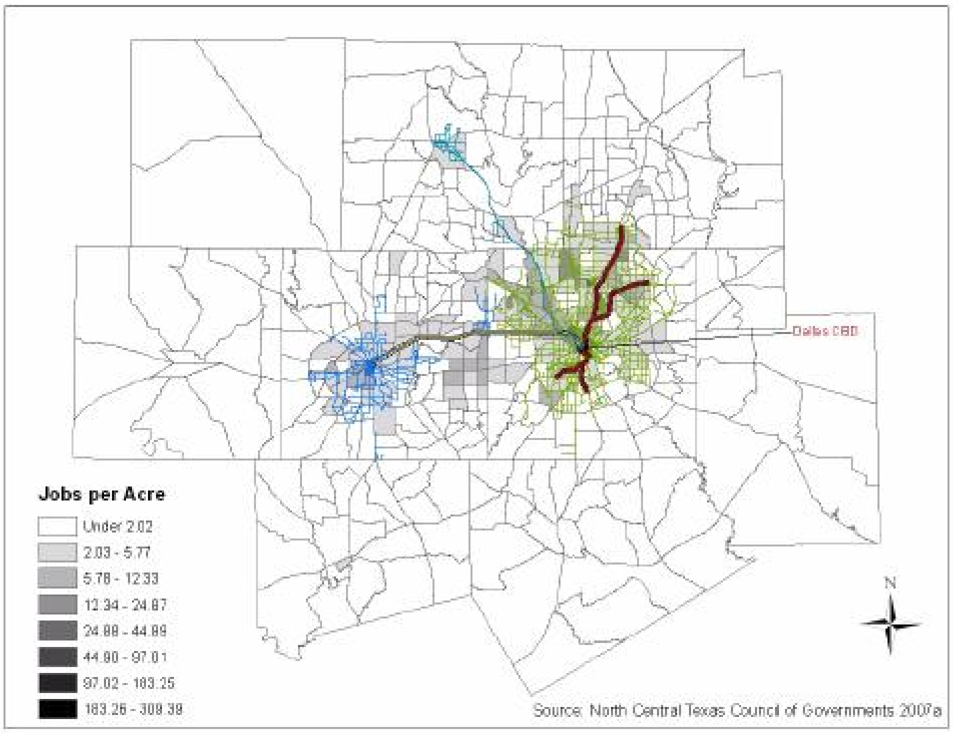


Figure 25 Regional destinations and transit system in Dallas-Fort Worth

In Minneapolis, the transit system long embraced an express bus oriented system to provide long-distance service to the CBD. Figure 26 shows that Metro Transit provides numerous bus connections from suburban areas to the Minneapolis CBD and inner core of the region. Bus routes are shown in blue and LRT in yellow, overlaid on a map of employment density. However, despite the strong CBD orientation of the system, the CBDs have been in relative, and in more recent years, absolute decline, and so has the transit system's riding habit and productivity. The authors do not see at this time a coherent regional transit development policy emerging that recognizes the very dispersed and multidestination nature of this far-flung region. There are hopeful signs that such a policy may emerge, perhaps as a result of the current major bus restructuring being undertaken by Metro Transit. But there are also numerous signs that a region-wide perspective is still lacking, most notably in the case of radial commuter rail line development to serve the CBD without taking into account its potential leveraging by connecting bus services or its role in a regional transit network.

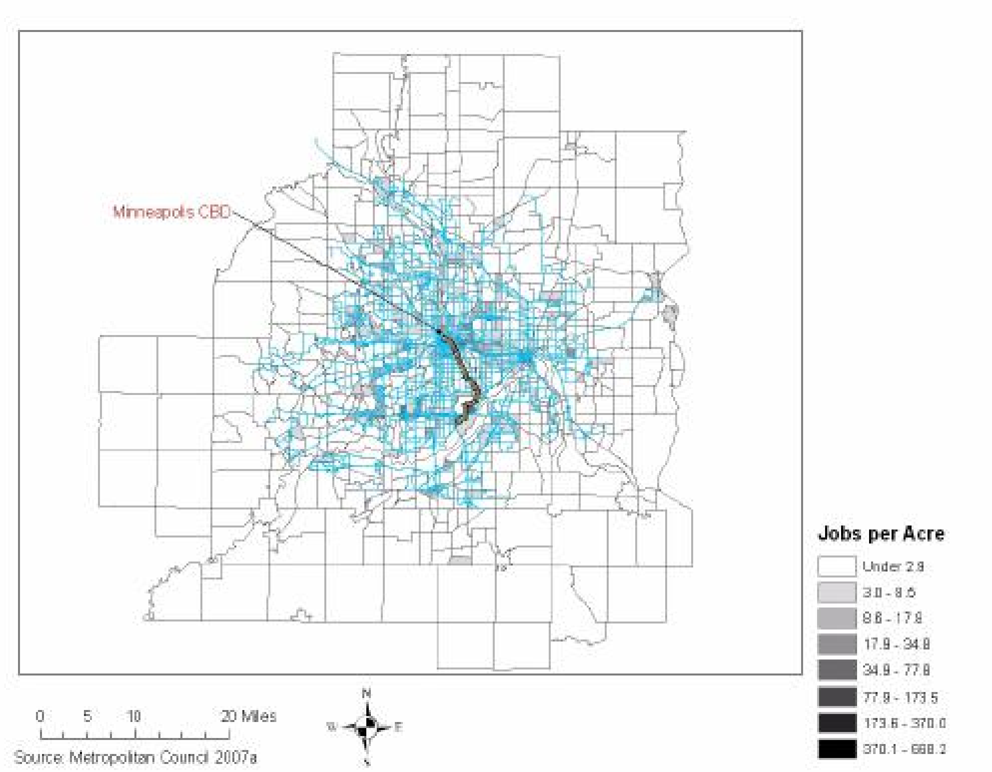


Figure 26 Regional destinations and transit system in Twin Cities, Minnesota

In Miami, Miami-Dade Transit has done a nice job using a multidestination system to connect the wide array of destinations in its service area (see Figure 27). However, the transit agency's riding habit and productivity suffer due to poor alignment decisions, which were discuss earlier in the guidebook and in the case study section. The most striking finding from the authors' examination is the absence of regional transit planning, regional service coordination, or regional transit services. Each of the three counties in the metropolitan area has its own transit system, which has typically operated in isolation from the region's other operators. The creation of the South Florida Regional Transportation Authority (SFRTA) may help to facilitate regional transit planning and service coordination, while improvements to Tri-Rail might facilitate the development of regional transit service. Since its inception, Tri-Rail's service has been too irregular, infrequent, and unreliable to be more than a commuter rail service that is largely isolated from the rest of the transit network in the Miami MSA. Now that Tri-Rail's double-tracking program is complete, however, service frequency is improving to the point where the line is beginning to function more like a regional rapid transit line such as a BART or WMATA line. As such it has the potential of knitting together the local bus lines in Miami-Dade, Broward, and Palm Beach Counties. Its utility in this regard would be increased if it is extended south (as planned) to the southern part of Dade County.

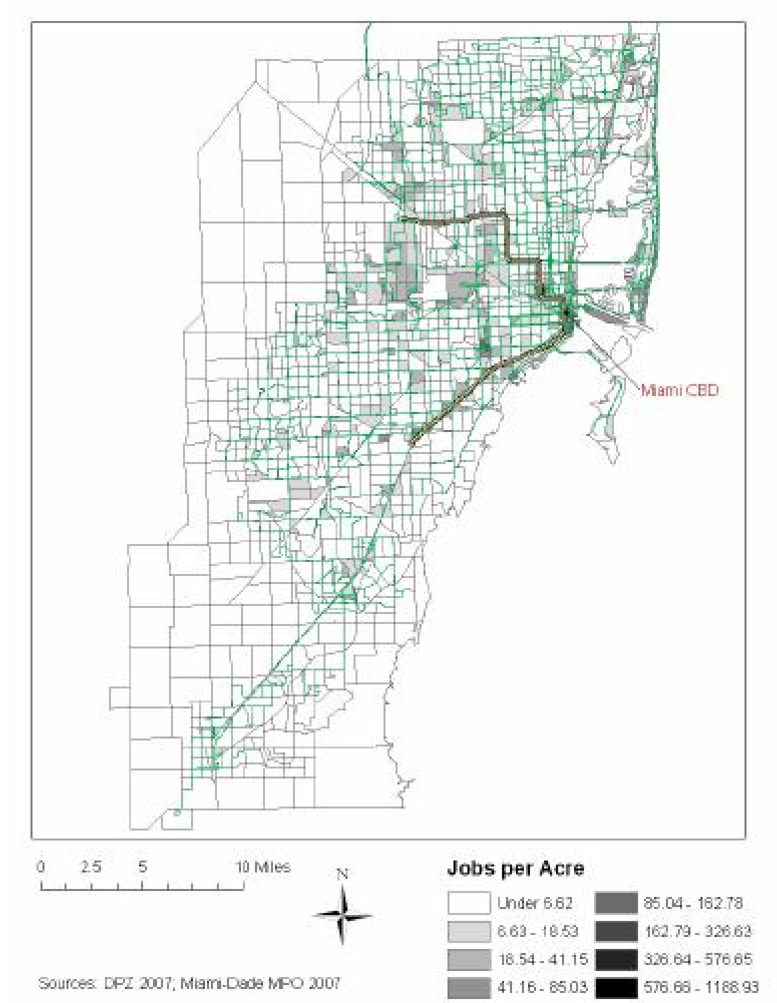


Figure 27 Regional destinations and transit system in Miami

Salt Lake City's transit system at least superficially matches the pattern of activity centers shown in Figure 28. However, the poor quality of the bus service and the lack of meaningful bus-rail integration, at least to date, have hampered its riding habit and productivity, as was noted earlier in the guidebook. Salt Lake City may want to follow the strategy embraced in Portland, Oregon and de-emphasize its arterial radial bus routes serving the CBD, unless they serve lots of employment in their respective corridors and improve service on the east-west arterials that serve lots of employment. This would allow people using bus to reach more regional destinations more easily than at the present, and would undoubtedly increase ridership and productivity. It would require better coordination of rail and bus that would allow rail to play a role as a distributor of riders to various connecting bus routes, such as occurs in Atlanta with MARTA.

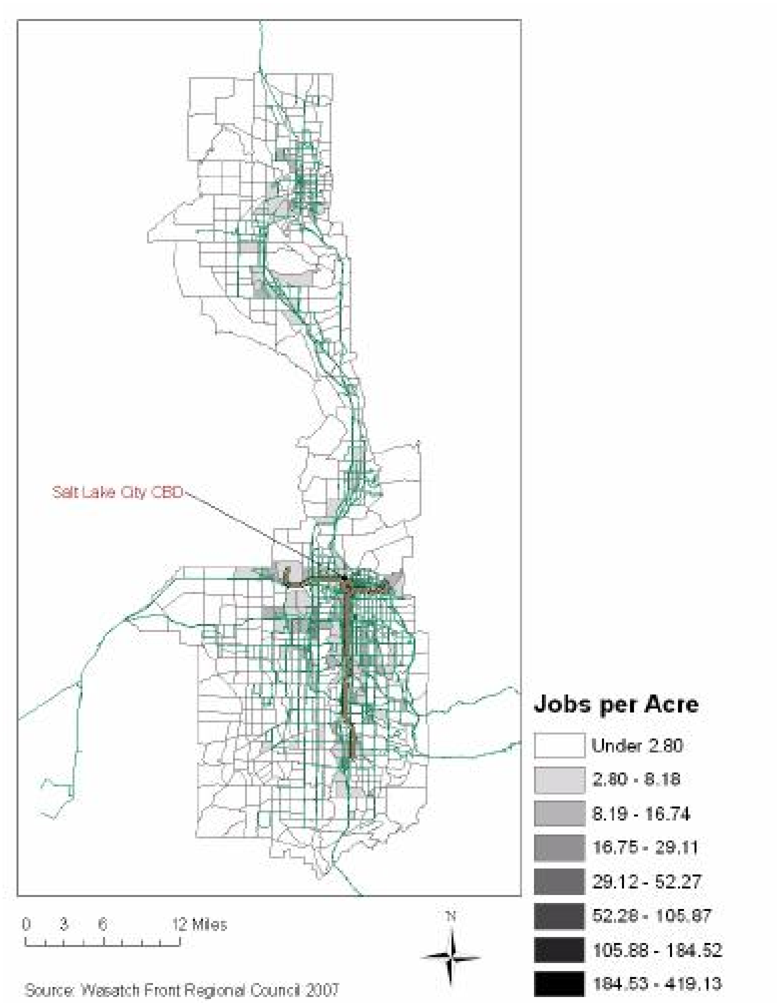


Figure 28 Regional destinations and transit system in Salt Lake City, Utah

In Sacramento, the transit agency originally embraced a multidestination, regional vision, but has backtracked significantly with its recent LRT investments. Figure 29 overlays the transit system on an employment density map. Some deficiencies in the regional transit system are immediately apparent from this map. The LRT system provides what has been and could still be a skeleton for the larger transit system, but it suffers from some notable handicaps. The most notable handicaps is the lack of connecting bus service to the end of the LRT line in Folsom, at the eastern end of the longest LRT line. Folsom is a major employment center in the region, and could become a major travel destination for LRT riders.

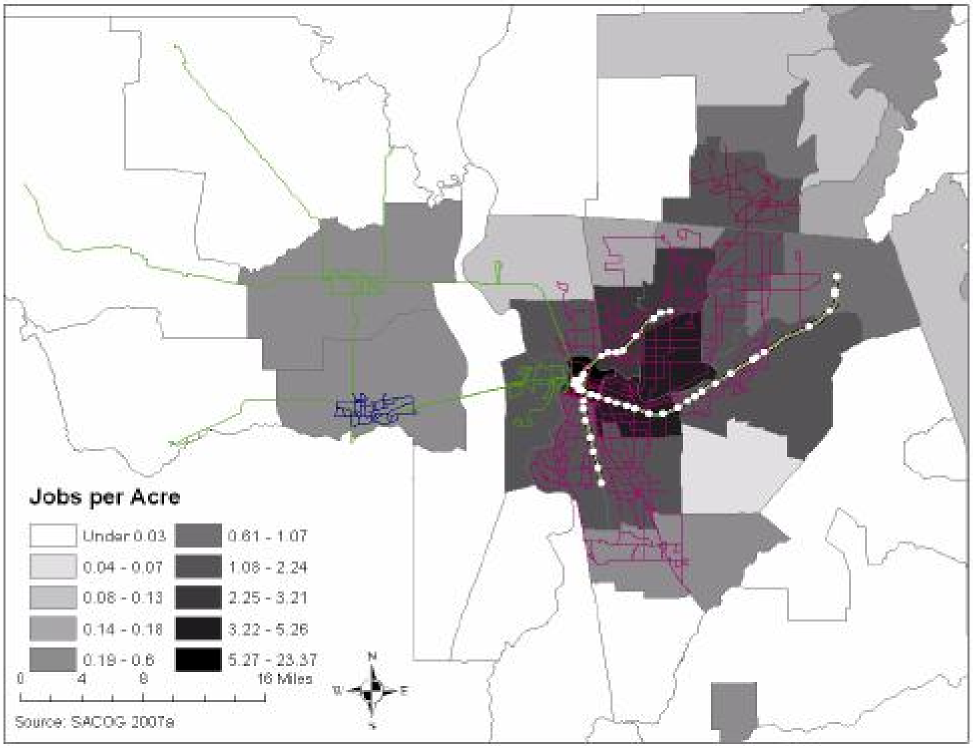


Figure 29 Regional destinations and transit system in Sacramento, California

This study's examination of San José reveals that the alignment of the LRT follows, at least roughly, the patterns of major activity centers. However, buses do not connect sizable parts of the residential districts of Santa Clara County with the light rail line spine, which, if they did so, could function as a distributor to a large number of jobs. It is as though the ribs have been broken off the spine and lie more or less parallel to it. This quality is particularly pronounced for the populous west side of the valley, north of the CBD. Just to the east of this area runs the north-south Guadalupe Corridor light rail line with stations at major employers. It would be a natural for east-west buses to run through the populous areas west of the Guadalupe Corridor before intersecting with it. If they did, bus passengers could change to trains to access jobs both north and south. By and large, such connections are missing. Figure 30 provides a concept map of how bus routes (shown in purple, straight lines at angles in map) might be developed to connect with both the LRT (shown in red, dark grayscale lines) and the Caltrain (approximate location shown in blue, descending upper left to lower right in map) to form a more integrated system that connects residential and employment centers to one another

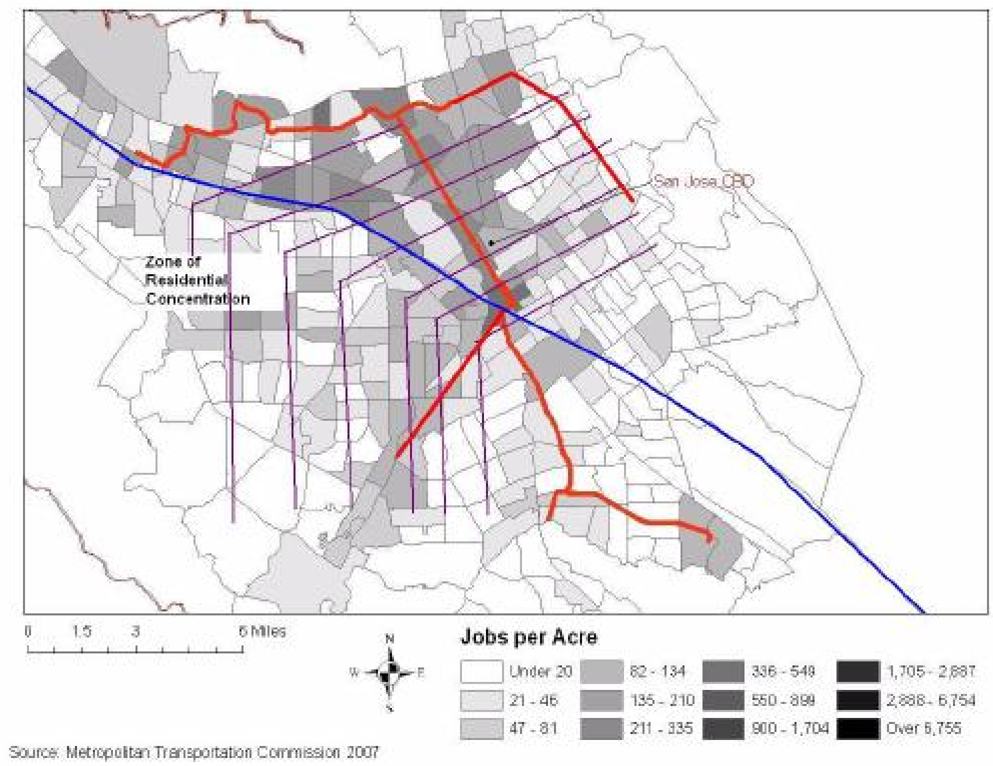


Figure 30 Regional destinations and hypothetical transit system in San José, California

In Pittsburgh, the transit system has a strong CBD focus (see Figure 31 which overlays the Port Authority of Allegheny County (PAT) system on a map of employment density). PAT has achieved tremendous success in capturing a large (50%) share of the CBD commute market; unfortunately this is a declining market. PAT has not achieved success in taking transit patrons to other destinations outside the central core, a record standing in contrast to that of most other metropolitan areas that were studied.

Pittsburgh has invested in busways and light rail transit, but none of these investments facilitates the development of a truly regional system. Pittsburgh's transit service covers most of the metropolitan area, but does so in order to connect outlying areas with the CBD. This is quite different from other metropolitan areas whose systems are designed to serve origins and destinations scattered throughout the region. Pittsburgh has invested heavily in three busways focused on providing rapid peak-hour bus service from commuter neighborhoods into downtown Pittsburgh. Pittsburgh's rail investment is confined to one corridor. These major transit investments have done little to facilitate transit travel to other transit destinations in the region, however, and little such travel has materialized. This lack of facilitation stands in contrast to, for example, Atlanta's (MARTA) rapid transit investments which, while also centered on Atlanta's CBD, also enabled the restructuring of the bus transit system to reach suburban destinations. As a consequence, the growth of suburban Atlanta jobs that are served by this system translate into growing suburban transit patronage which makes use of both the rail line and the bus lines that are integrated together into a single network. This suburban-oriented demand keeps Atlanta's transit productivity high whereas the growth of suburban jobs in Pittsburgh fails to stimulate transit demand.

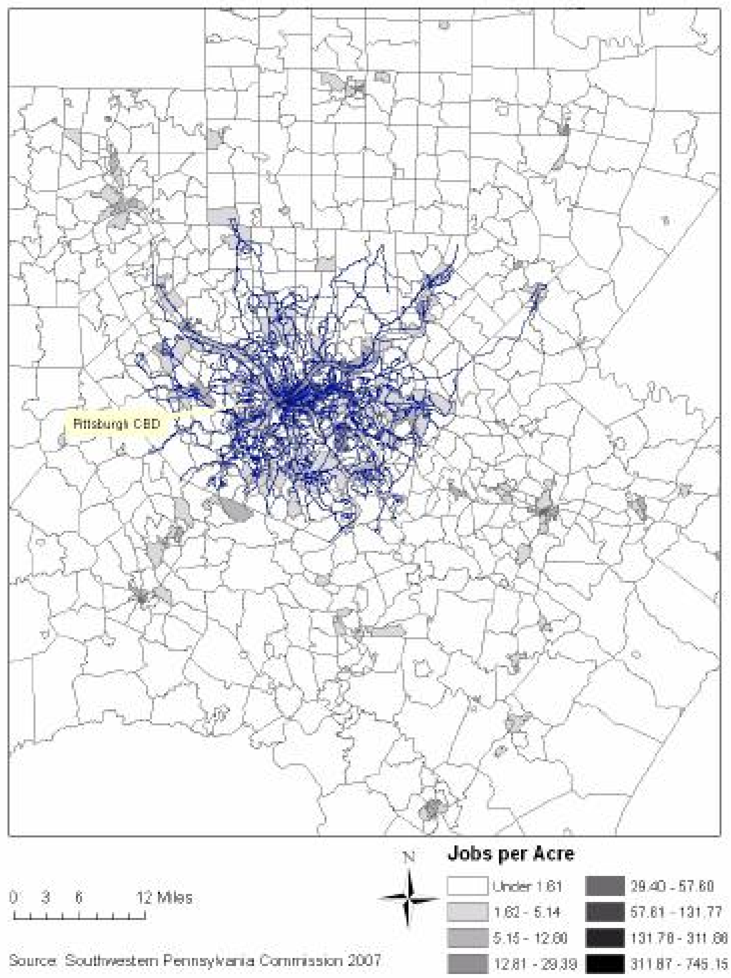


Figure 31 Regional destinations and transit systems in Pittsburgh

In conclusion, the analysis clearly indicates that the most successful transit systems provide high-quality service to the array of major activity centers throughout the region. The rail system serves as a backbone for the regional transit service strategy. Less successful systems either serve only a limited portion of the region or prioritize serving one major activity center, the CBD, despite the fact that this center is in relative decline in nearly all the study areas. As the discussion of Atlanta indicates, extending the reach of a successful sub-regional system to an entire region is not an overwhelming task from a logistical and planning perspective, although in certain settings it may require a vote of the electorate or legislative action.

An Exemplary Transit System: Portland

Over the past 25 or so years the Portland metropolitan area's transit system has performed the best of the eleven metropolitan areas in this study. Riding habit consistently has improved as has service productivity. During this time rail went from accounting for none of the region's transit patronage to about 43% measured in passenger miles, which occurs on an LRT infrastructure of about 48 miles in length (including the streetcar). Rail now is the center piece of the Portland regional transit system and clearly plays a part in its success.

Attributes of the system that contribute to its success are several. These include:

1. Partial reorganization of the bus routes into a grid running on arterial roads with lots of activity, connecting with rail for access to the CBD and other major destinations;
2. Having the rail lines intersect with several of the grid bus routes as described above, two of these are the first and second most heavily patronized bus routes in the system;
3. In other parts of the city, reorganizing bus routes into timed transfer networks;
4. Routing the rail lines to "plug" into several such timed transfer centers;
5. Routing rail lines to serve sectors of the region that are rapidly growing in both employment and population;
6. Having regional planning and zoning policies in place, prohibiting low density, auto oriented activities near stations and encouraging high density activities in their place, thereby harnessing the market forces already extant in the high growth corridors to develop the land with dense land uses and transit access; and
7. Keeping regional rail services relatively fast. (However, the slow movement of trains through the central city is a problem here.)

Regional control of land use development appears to play a major role, as well. Apparently because of the urban growth boundary, the degree of employment decentralization is less than in other regions in this study, and most of such decentralization has occurred within the transit service area, in many instances relatively close to rail lines. Unlike some other regions in the study, such as Atlanta and Dallas, there are not large employment destinations in the Portland region that remain unserved by transit, and thus transit patronage is not depressed by unserved employment as it is in some other regions (see Figure 21). Similarly, population decentralization has occurred primarily within the transit service area. There are no other metropolitan regions close enough to Portland, with the exception of Vancouver, to lure employees within the region to residences outside of the region, a trend that appears to be depressing transit in some of the other study areas, such as San Diego.

There are areas of concern, particularly related to the intensifying CBD focus to the rail investments. Having the Interstate MAX line come downtown requires large investment to rebuild the transit mall that would have been unnecessary had that line remained on the east side of the river, where it would have served major employment concentrations that remain unserved by rail. The very slow speed of trains running through the downtown also mitigates against success in serving the demand of workers living on the east side of the region to reach jobs in the western part of the region. The strong CBD focus of the bus system is also an area of potential concern given the wide array of non-CBD travel destinations in the region.

Portland's CBD, while healthy, has not grown relative the regional employment, as has been the case in Miami and Denver. Yet, transit does better in Portland. Clearly, pro-downtown policies contribute to Portland's transit success but they are not the only reason for it.

APPENDIX A
ATLANTA, GEORGIA

SETTING

The Atlanta Metropolitan Statistical Area (MSA) consists of 28 counties in northwest Georgia with a total land area of just under 8,400 square miles.[97] With 4.9 million persons in 2005, the Atlanta MSA ranks as the nation's ninth largest in population.[98] The Atlanta MSA's population density is just under 590 persons per square mile.

Five counties represent the center of population and employment in the Atlanta MSA: Clayton, Cobb, DeKalb, Fulton, and Gwinnett (see Figure 32). The authors refer to these counties as the MSA core counties. Two of these counties, DeKalb and Fulton, contain the majority of metropolitan transit service and ridership. These two counties are the service area for the Metropolitan Atlanta Rapid Transit Authority (MARTA); hence, they are referred to as the MARTA service area. The remaining 26 MSA counties lie outside the MARTA service area.

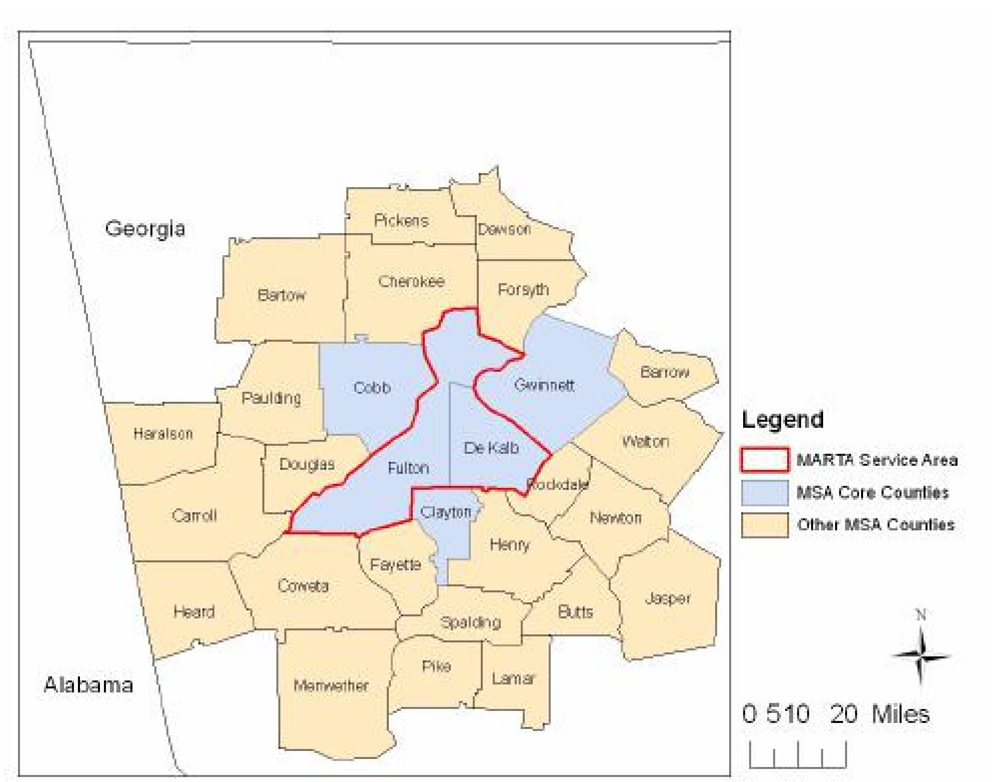


Figure 32 Atlanta metropolitan statistical area

Distribution of MSA Population

Atlanta is a rapidly growing, and increasingly decentralized, metropolitan area. Population has decentralized considerably since 1970, as shown in Figure 33. This figure provides maps of population by county in 1970, 1980, 1990, and 2000, using a common classification scheme. Overlaid on the map frames for 1980, 1990, and 2000, is the MARTA rail system at that moment in time.[99] The maps show a gradual spreading of population from Fulton and DeKalb counties first to the inner suburban counties of Clayton, Cobb, and Gwinnett, and then to other counties throughout the metropolitan area.

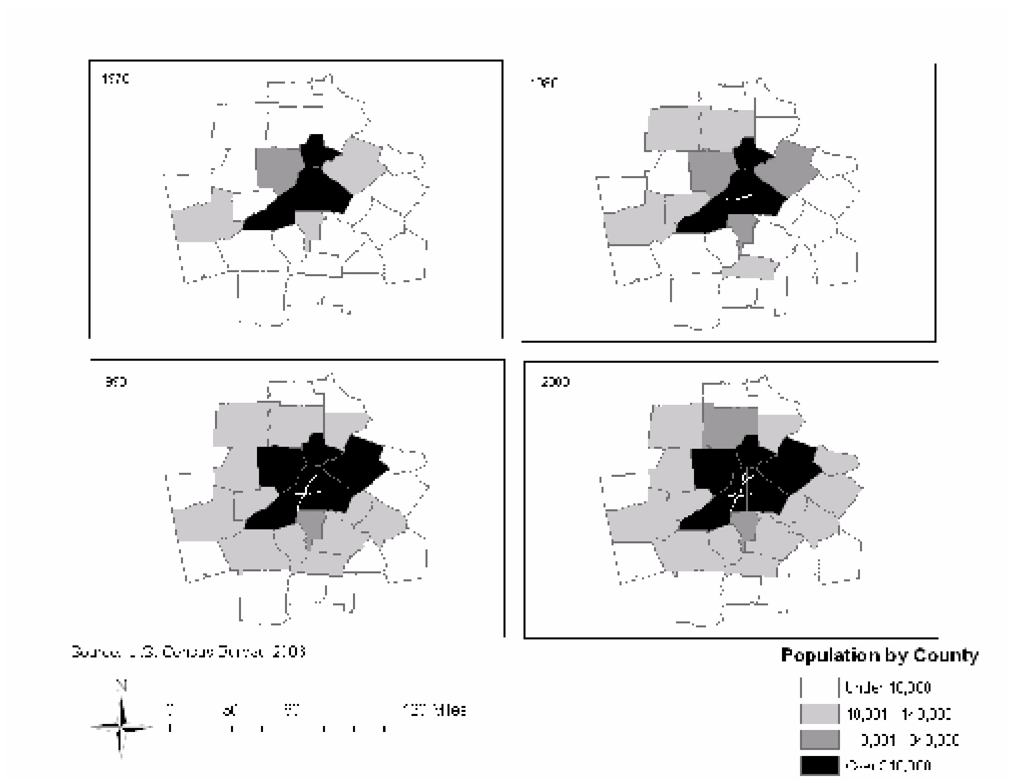


Figure 33 Atlanta MSA: Population by county (1970–2000)

Between 1970 and 2005, total MSA population increased 167% from 1.8 million to 4.9 million persons (see Table 21). Population growth in Fulton and DeKalb counties, referred to in the table as the MARTA service area, has been much slower (56%) than in the rest of the MSA (306%). In 1970, Fulton and DeKalb counties accounted for 55% of the MSA population; today they account for less than one-third of the MSA population. Just over two-thirds of the MSA population resides in the five MSA core counties. These five counties occupy about 1,700 square miles and have an average population density of 1,900 persons per square mile. The remaining 23 counties occupy 6,600 square miles and have an average population density of 250 persons per square mile.[100]

Table 21 Population in the metropolitan Atlanta area (1970–2005)

Year	MARTA Service Area (2 counties)	MSA Core Counties (5 counties)	Outside MARTA Service Area (26 counties)	Total MSA (28 counties)
1970	1,020,597	1,387,865	819,683	1,840,280
1971	1,043,800	1,436,700	869,500	1,913,300
1972	1,069,700	1,481,800	906,400	1,976,100
1973	1,067,100	1,518,200	977,400	2,044,500
1974	1,065,000	1,550,700	1,033,300	2,098,300
1975	1,054,800	1,557,100	1,061,900	2,116,700
1976	1,049,300	1,568,700	1,092,500	2,141,800
1977	1,054,800	1,596,700	1,128,700	2,183,500
1978	1,059,000	1,623,500	1,165,000	2,224,000
1979	1,070,400	1,662,500	1,213,700	2,284,100
1980	1,072,928	1,687,818	1,253,623	2,326,551
1981	1,090,230	1,735,376	1,301,296	2,391,526
1982	1,099,402	1,769,421	1,342,221	2,441,623
1983	1,113,706	1,816,064	1,390,813	2,504,519
1984	1,128,459	1,871,675	1,453,244	2,581,703
1985	1,149,954	1,939,908	1,527,238	2,677,192
1986	1,166,254	2,003,582	1,606,285	2,772,539
1987	1,179,240	2,063,280	1,689,952	2,869,192
1988	1,187,980	2,114,406	1,764,643	2,952,623
1989	1,192,997	2,153,209	1,827,319	3,020,316
1990	1,200,352	2,191,036	1,890,926	3,091,278
1991	1,225,534	2,250,436	1,956,803	3,182,337
1992	1,252,606	2,315,961	2,016,144	3,278,750
1993	1,283,883	2,394,201	2,104,833	3,388,716
1994	1,319,095	2,473,193	2,190,961	3,510,056
1995	1,348,247	2,550,166	2,282,500	3,630,747
1996	1,380,567	2,622,549	2,371,161	3,751,728
1997	1,405,853	2,694,377	2,468,115	3,873,968
1998	1,435,415	2,770,315	2,571,019	4,006,434
1999	1,463,990	2,850,396	2,678,598	4,142,588
2000	1,481,871	2,914,587	2,767,072	4,248,943
2001	1,518,816	3,017,184	2,909,042	4,427,858
2002	1,357,686	3,078,190	3,013,036	4,550,772
2003	1,561,237	3,140,262	3,114,151	4,675,388
2004	1,580,137	3,199,590	3,216,131	4,796,268
2005	1,593,582	3,251,639	3,324,135	4,917,717

Source: U.S. Census Bureau, 2006.

Figure 34 displays population density inside the five Atlanta MSA core counties for 2005. The map plots persons per acre by census tract, using classification categories based on natural breaks in the data. The map indicates that population is widely dispersed inside the MSA core counties, with higher population densities in the center of the metropolitan core and in corridors that follow the metropolitan area's freeways and other major roads.

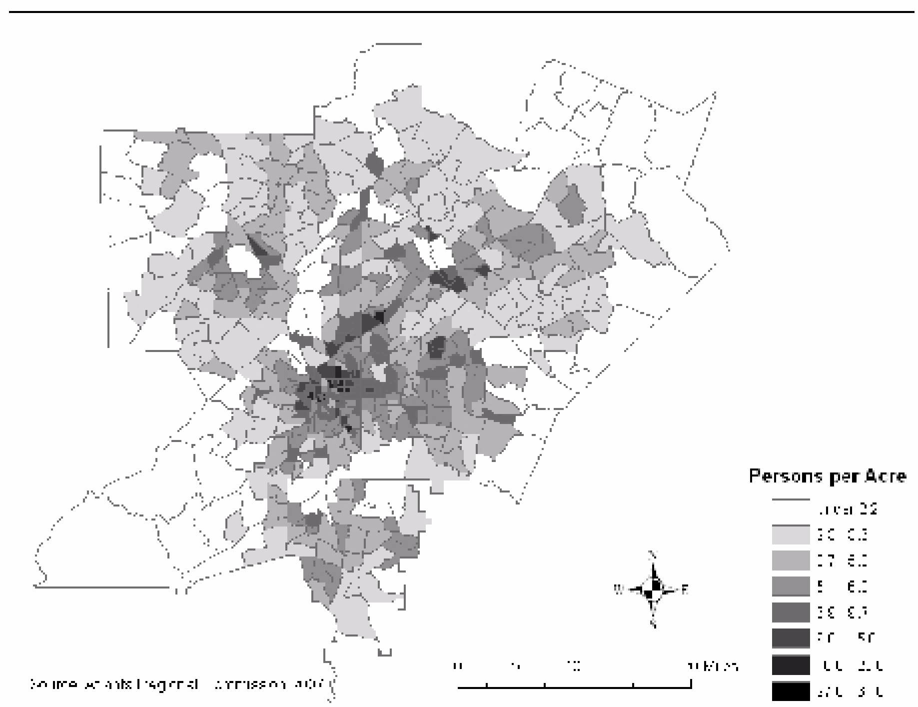


Figure 34 Atlanta MSA core counties: population density by census tract (2005)

Distribution of MSA Employment

Employment has also grown and decentralized over the past several decades, but it remains much more concentrated than population. Figure 35 provides maps of employment by county in 1970, 1980, 1990, and 2000, using a common classification scheme. Overlaid on the map frames for 1980, 1990, and 2000 is the MARTA rail system at that moment in time.[101] The maps show a gradual spreading of employment from Fulton county first to DeKalb and Cobb counties and then to Gwinnett and Clayton counties. The maps show very little employment outside the MSA core counties.

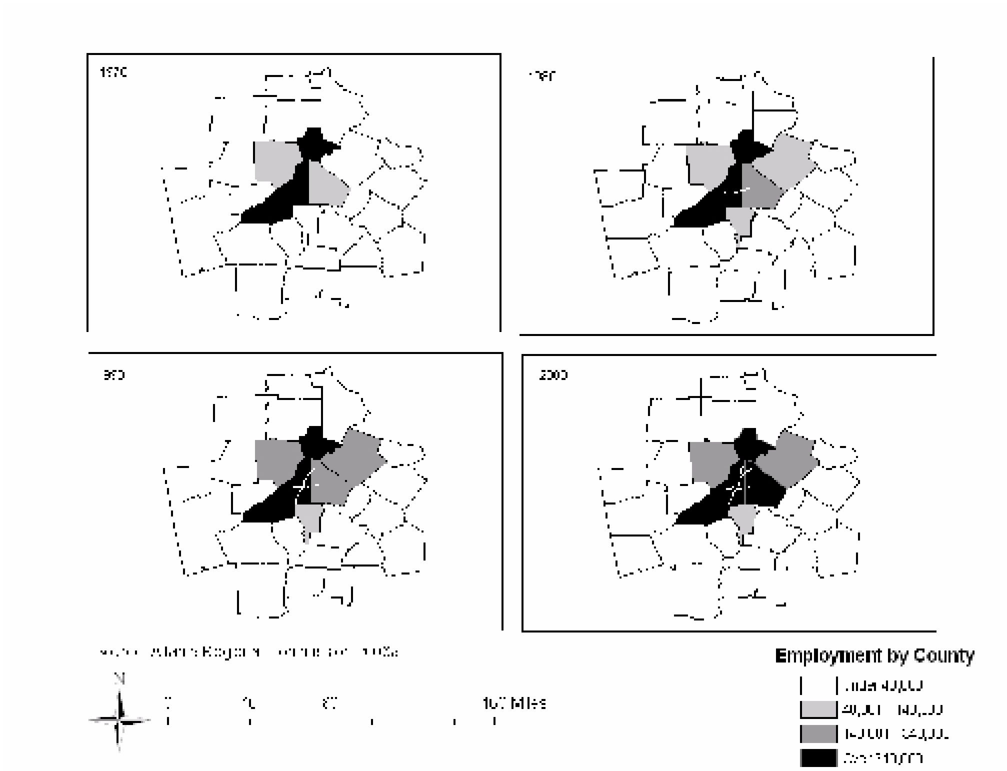


Figure 35 Atlanta MSA: employment by county (1970–2000)

Over the past several decades, employment increased rapidly as Atlanta strengthened its position as the dominant employment center of the Southeastern United States. Between 1970 and 2005, total MSA employment increased 260% from 638,000 to 2.3 million jobs (see Table 22). Employment growth inside the MARTA service area has been much slower (123%) than employment growth in the rest of the MSA (610%). In 1970, Fulton and DeKalb counties accounted for 72% of all jobs in the MSA; by 2005, they accounted for approximately 45% of all jobs in the MSA. However, most of the suburban employment growth has occurred in the nearby core counties of Clayton, Cobb, and Gwinnett. In 2005, more than three-fourths of all jobs in the MSA were located in the five core counties.

Within the MARTA service area, employment has also decentralized. The Atlanta central business district (CBD) has added jobs since 1970, but most of that employment growth occurred between 1970 and 1980. From 1980–2005, employment in the CBD increased 14% from 93,000 to 106,000 jobs. Atlanta CBD employment reached a peak in 2000 and has declined since that time. By contrast, employment growth in suburban portions of the MARTA service area has been relatively steady between 1970 and 2005.

Table 22 Employment in the Atlanta metropolitan area (1970–2005)

Year	MARTA Service Area (2 counties)			MSA Core Counties (5 counties)	Outside MARTA Service Area (26 counties)	Total MSA (28 counties)
	Atlanta CBD	Outside Atlanta CBD	Total			
1970	52,122	406,902	459,024	534,612	179,186	638,210
1971	55,234	405,373	460,607	531,247	176,538	637,145
1972	58,531	434,236	490,767	570,396	194,718	685,485
1973	62,025	468,610	530,636	619,816	212,102	742,738
1974	65,728	465,460	531,189	633,412	229,895	761,083
1975	69,652	433,646	503,298	604,980	218,550	721,848
1976	73,811	439,607	513,418	626,592	237,943	751,361
1977	78,217	444,089	522,306	654,933	264,043	786,349
1978	82,887	481,002	563,888	716,038	297,431	861,319
1979	87,835	510,695	598,530	773,147	326,941	925,471
1980	93,064	570,419	663,483	861,523	360,953	1,024,436
1981	94,255	588,817	683,072	901,127	387,175	1,070,247
1982	96,462	607,920	703,382	943,259	416,089	1,119,471
1983	96,684	627,759	724,442	988,984	445,073	1,169,515
1984	97,921	648,366	746,287	1,037,770	485,486	1,231,773
1985	99,171	669,760	768,931	1,090,203	522,162	1,291,093
1986	100,242	689,513	789,755	1,134,409	554,117	1,343,872
1987	101,325	709,819	811,144	1,181,072	593,301	1,404,455
1988	102,419	730,693	833,112	1,230,377	632,407	1,465,519
1989	103,525	752,149	855,674	1,282,526	677,252	1,532,927
1990	104,619	774,281	878,900	1,337,800	718,930	1,597,830
1991	104,232	787,961	892,193	1,371,493	741,781	1,633,975
1992	103,846	801,865	905,711	1,406,481	776,415	1,682,126
1993	103,462	815,995	919,457	1,442,829	812,953	1,732,410
1994	103,079	830,356	933,435	1,280,608	854,742	1,788,177
1995	102,695	845,105	947,800	1,520,000	898,927	1,846,727
1996	105,170	867,115	972,285	1,575,860	952,720	1,925,005
1997	107,705	889,801	997,506	1,632,456	1,006,897	2,004,403
1998	110,300	913,300	1,023,600	1,692,350	1,055,498	2,079,098
1999	112,958	941,242	1,054,200	1,762,650	1,113,255	2,167,455
2000	115,704	962,096	1,077,800	1,819,500	1,171,399	2,249,199
2001	113,644	945,516	1,059,160	1,794,593	1,170,377	2,229,537
2002	111,622	929,255	1,040,877	1,770,128	1,188,411	2,229,288
2003	109,637	913,363	1,023,000	1,746,200	1,194,494	2,217,494
2004	107,685	997,040	1,104,725	1,897,645	1,298,562	2,403,287
2005	106,249	916,293	1,022,542	1,779,745	1,272,231	2,294,773

Source: Atlanta Regional Commission, 2006a.

Figure 36 maps employment density by census tract in the five Atlanta MSA core counties for 2005, the most recent year for which detailed employment data are available. The map displays jobs per acre by census tract, using classification categories based on natural breaks in the data. The map indicates that while employment is dispersed, it is much more concentrated than population. The map also shows that most employment concentrations inside the MSA core counties are located to the north. Employment in Cobb County, to the northwest, and Gwinnett County, to the northeast, tends to either cluster near the Fulton and DeKalb County boundaries or follows major roadway corridors. The Atlanta CBD is but one of many employment concentrations in the core counties.

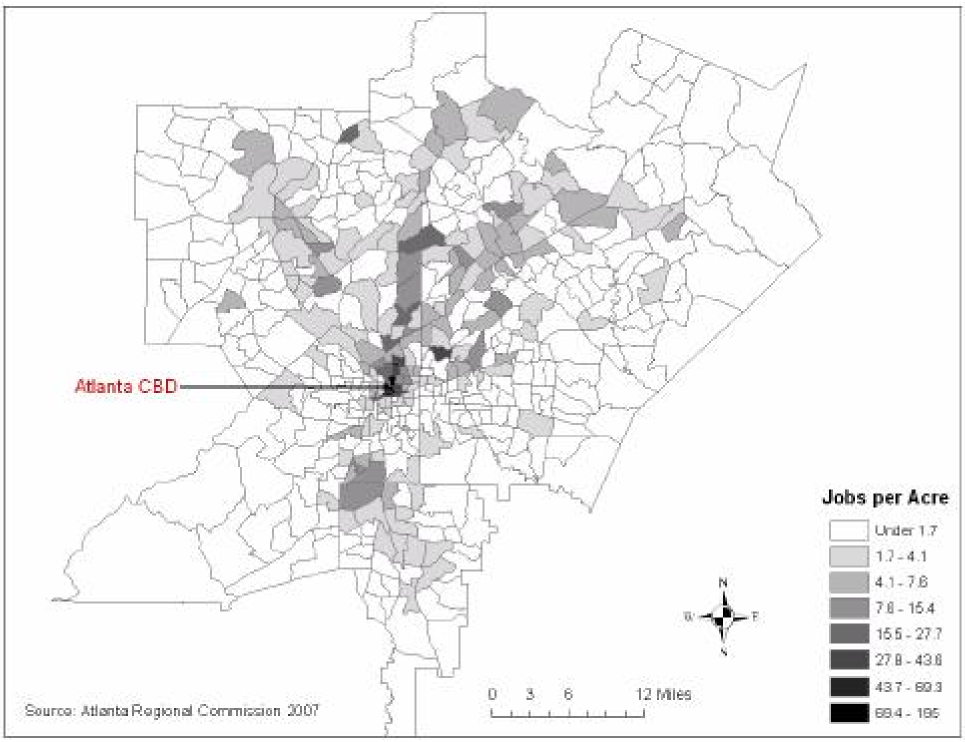


Figure 36 Atlanta MSA core counties: employment density by census tract (2005)

The Atlanta MSA clearly emerges from this brief examination of population and employment growth and distribution as a growing, decentralized metropolitan area. However, it also emerges from the examination that most employment within the metropolitan area is located in clusters or corridors that are not far removed from the center of the metropolitan area. Some of these clusters lie within the MARTA service area, and are served by MARTA, while others lie outside the MARTA service area but could potentially be connected to MARTA rail stations via a handful of trunk routes. The pattern of potential travel destinations thus has clear implications for the structure of the transit systems in the region, as will be explored later in the case study discussion.

Institutions and Key Actors

Several public agencies and private organizations play important roles in the transit planning and policymaking process in Atlanta. The Atlanta Regional Commission (ARC), Georgia Department of Transportation (GDOT), Georgia Regional Transportation Authority (GRTA), and Metropolitan Atlanta Rapid Transit Authority (MARTA) are key government actors in the planning and policymaking process, while the Metro Atlanta Chamber of Commerce plays an important private sector role. By virtue of their powers of appointment to the MARTA Board of Directors, the Mayor of Atlanta, the County Commissions of Clayton, DeKalb, Fulton, and Gwinnett Counties, and the Governor of Georgia also play important roles.

Atlanta Regional Commission

The Atlanta Regional Commission (ARC) serves as the Metropolitan Planning Organization (MPO) for the Atlanta metropolitan area. The MPO Board includes local elected officials and citizen members from 10 member counties. As the MPO, ARC is responsible for conducting the transportation planning process required as a prerequisite to obtaining federal highway and transit aid. ARC is also active in the recently created Transit Planning Board (TPB) which is charged with developing a regional transit vision for the Atlanta metropolitan area.

Georgia Department of Transportation

The Georgia Department of Transportation (GDOT) is represented on both the Transit Planning Board (TPB) and the MARTA Board.

Georgia Regional Transportation Authority

The Georgia Regional Transportation Authority (GRTA) was created by state legislation in 1999, and given responsibility for reviewing and approving transportation, air quality, and land use plans in the 13 county non-attainment area for ozone and particulate matter. GRTA also operates both a regional express bus system and the local bus transit system in Clayton County (C-TRAN), and it is represented on both the Transit Planning Board and the MARTA Board. The GRTA Board includes 15 members appointed by the Governor of Georgia.

Metropolitan Atlanta Rapid Transit Authority

Created by state legislation in 1965, the Metropolitan Atlanta Rapid Transit Authority (MARTA) operates the local bus and rail transit system in Fulton and DeKalb Counties. The MARTA Board includes 18 members selected to represent the City of Atlanta, Clayton County, DeKalb County, Fulton County, Gwinnett County, the State Properties Commission & Georgia Building Authority, the Georgia Regional Transportation Authority, the Georgia Department of Revenue, and the Georgia Department of Transportation.

Metro Atlanta Chamber of Commerce

The Metro Atlanta Chamber of Commerce is the leading business organization in the Atlanta area. The Chamber played an important role as an advocate for the development of rail transit in Atlanta. In recent years, the Chamber has emerged as a forceful advocate for high occupancy vehicle lanes, express bus service, and commuter rail service in the region.

Transit Planning Board

A recent institutional creation is the Transit Planning Board (TPB). Housed in GRTA, the TPB includes representatives of ARC, GRTA, GDOT, MARTA, the Mayor of Atlanta, and the Chairpersons or Chief Executive Officers of eleven local counties. The TPB is charged with developing a regional vision for transit and identifying the financial means to pay for it.

Transit Agencies, Modes, Fares, and Rider Profiles

Five public transit agencies provide fixed-route transit service in the Atlanta MSA: Clayton County Transit (C-TRAN), Cobb Community Transit (CCT), Gwinnett County Transit (GCT), Georgia Regional Transportation Authority (GRTA), and Metropolitan Atlanta Rapid Transit Authority (see Figure 37). With the exception of a few express routes that connect outer area park and ride lots with the Atlanta CBD, the transit services operated by these five transit agencies are confined to the core counties: Clayton, Cobb, DeKalb, Fulton, and Gwinnett.

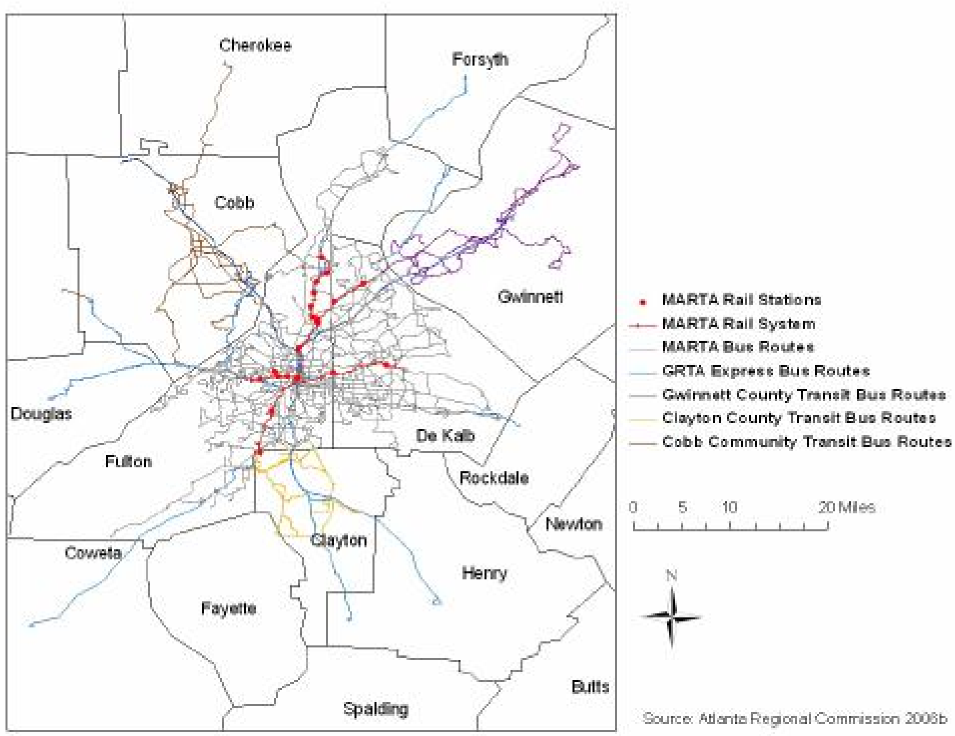


Figure 37 Transit systems in the Atlanta metropolitan area (2007)

Small Transit Agency Services, Fares, and Ridership

Combined, C-TRAN, CCT, GCT, and GRTA carried 11 million unlinked passenger trips for a total of 65 million passenger miles in 2004 (see Table 23). This combined total represents less than 10% of the Atlanta MSA's total transit ridership. Because these agencies carry a small proportion of MSA transit ridership, the authors will briefly describe their service and ridership profile in this section, but will focus on MARTA in the remainder of the case study.

Table 23 Transit ridership (passenger miles) on non-MARTA systems (1990–2004)

Year	Cobb Community Transit	Georgia Regional Transportation Authority	Gwinnett County Transit
1990	13,728,177		
1991	17,298,994		
1992	18,889,978		
1993	19,332,611		
1994	21,312,557		
1995	21,211,960		
1996	23,861,290		
1997	17,703,024		
1998	18,524,812		
1999	16,575,204		
2000	22,913,336		
2001	22,784,732		
2002	25,400,805	3,552,294	8,534,287
2003	27,514,591	2,120,433	17,166,366
2004	30,411,049	5,122,322	30,084,194

Source: Florida Department of Transportation, 2006.

Created in 2001, Clayton County Transit (C-TRAN) provides local bus service between Atlanta Hartsfield Jackson International Airport and other destinations in the county. Clayton County contracts with the Georgia Regional Transportation Authority (GRTA) to operate five local bus routes. These routes operate on 30-minute peak and 60-minute off-peak weekday headways, and all routes provide connections to the MARTA rail station at the airport. As of June 2007, C-TRAN's base fare is $1.50.[103] C-TRAN discounts this fare for senior citizens, the disabled, children under 5 (who ride free), and individuals who purchase multi-trip ride passes or monthly passes. C-TRAN riders transfer free to and from MARTA bus and rail services. C-TRAN ridership statistics are reported as part of the GRTA ridership statistics in the National Transit Database (NTD), so the authors are unable to determine whether C-TRAN patronage is growing, stagnant, or declining.

Created in 1990, Cobb Community Transit (CCT) provides local bus service inside Cobb County and local and express bus service to MARTA stations inside Fulton County. Most CCT routes provide a connection to one or more MARTA rail stations, and several, primarily express, routes provide service to the Atlanta CBD. As of June 2007, CCT's adult single-ride fare is $1.25.[103] CCT discounts this fare for all youths, all senior citizens, and individuals who purchase multi-ride tickets or monthly transit passes. Transfers between CCT and MARTA bus and rail services are free. CCT's fares are scheduled to increase on November 1, 2007, when the adult single-ride fare will become $1.50. Between 1990 and 2004, CCT ridership more than doubled, although this included periods of increased ridership that bracket a mid-1990s ridership decline.

Created in 2000, Gwinnett County Transit (GCT) operates five local routes inside Gwinnett County, one of which provides a connection to a MARTA rail station, and several express bus routes that provide connections to multiple MARTA stations. As of June 2007, GCT's adult single-ride fare is $1.75.[104] GCT discounts this fare for senior citizens, the disabled, persons under 18, and individuals who purchase multi-ride tickets or monthly passes. GCT riders transfer free to or from MARTA bus and rail services. National Transit Database statistics for GCT date back only to 2002. Ridership grew dramatically between 2002 and 2004, but largely as a function of a quadrupling of service miles during this period.

The Georgia Regional Transportation Authority (GRTA) began to operate peak-period, express bus service between suburban park-and-ride lots and the Atlanta CBD in 2004. GRTA originally operated two routes, but the number has since increased to 20 routes. All but three routes serve the Atlanta CBD; the three routes that do not serve the Atlanta CBD terminate at MARTA rail transit stations. As of June 2007, GRTA's regular fare was $3 one-way or $5 round trip for travel inbound in the morning and outbound in the evening; reverse commute fares are half these prices.[105] GRTA also sells multi-ride and monthly passes; a monthly reverse commute pass is available at half the regularly monthly pass price. GRTA riders can transfer to MARTA rail lines for free and can transfer from MARTA to GRTA for free at selected MARTA stations. In October 2006, GRTA carried an average of 4,375 daily riders on its express bus routes, or an average of approximately 219 riders per route.[106]

Small Transit Agency Rider Profile

During 2001 and 2002, the Atlanta Regional Commission conducted an on-board survey of passengers of local and regional transit systems.[107] The study developed ridership demographic profiles for the metropolitan area's smaller transit agencies, including C-TRAN, CCT, and GCT. The report presented data for C-TRAN and GCT as a combined total, labeled as Gwinnett/Clayton in the table shown below.

The demographic profiles are summarized in Table 24. The table indicates that on weekdays, there is a fairly even split between male and female riders. On the weekend, however, the proportions change significantly. Notably, CCT's proportion of male riders increases by 15 percentage points to 65%. The combined Gwinnett and Clayton transit systems reported a smaller change in the shares of male and female riders.

Table 24 Demographics of CCT and Gwinnett/Clayton county transit riders

Survey Category	Response	CCT Weekday Percent	CCT Weekend Percent	Gwinnett/Clayton Weekday Percent	Gwinnett/Clayton Weekend Percent
Gender	Male	50	65	52	59
	Female	50	35	48	41
Vehicle Availability	Yes	29	19	59	23
	No	71	81	41	77
Income	$0 to $29,999	55	58	40	48
	$30,000 to $59,999	30	28	29	44
	$60,000 to $99,999	10	13	21	0
	$100,000 or more	5	0	10	8

Source: Atlanta Regional Commission, "Regional On-Board Transit Survey 2001–2002," 42, 49, 53, 64, 70, 74.

The table indicates that CCT serves a more transit dependent ridership than do the combined Gwinnett and Clayton systems, particularly during the weekdays. More than half of both weekday and weekend CCT riders report incomes under $30,000, and more than 70% of both weekday and weekend CCT riders report having no vehicle available to them. The combined Gwinnett and Clayton systems serve weekday riders with higher incomes and vehicle availability than those on the CCT system. On the weekends, however, their riders are much more like those on the CCT system.

One explanation for the difference in ridership profiles is the large number of weekday, express bus routes offered by Gwinnett County Transit (GCT). These kinds of bus routes tend to serve higher income commuters, while local routes tend to attract more transit dependent riders.

Metropolitan Atlanta Rapid Transit Authority Services and Fares

The primary transit operator in the Atlanta MSA is the Metropolitan Atlanta Rapid Transit Authority (MARTA). Created by state legislation in 1965, MARTA operates the local bus and heavy rail transit systems in Fulton and DeKalb Counties. With the exception of a couple bus routes that just cross into Clayton and Cobb Counties, MARTA services are confined to Fulton and DeKalb Counties (see Figure 38). One reason for the geographic restriction of MARTA's service is the agency's reliance on county-based local option sales taxes to finance its capital and operating expenditures. Both Fulton and DeKalb counties have adopted one cent sales taxes to support MARTA service, while the other counties have not done so. The authors discuss MARTA ridership, service, and performance statistics later in the case study.

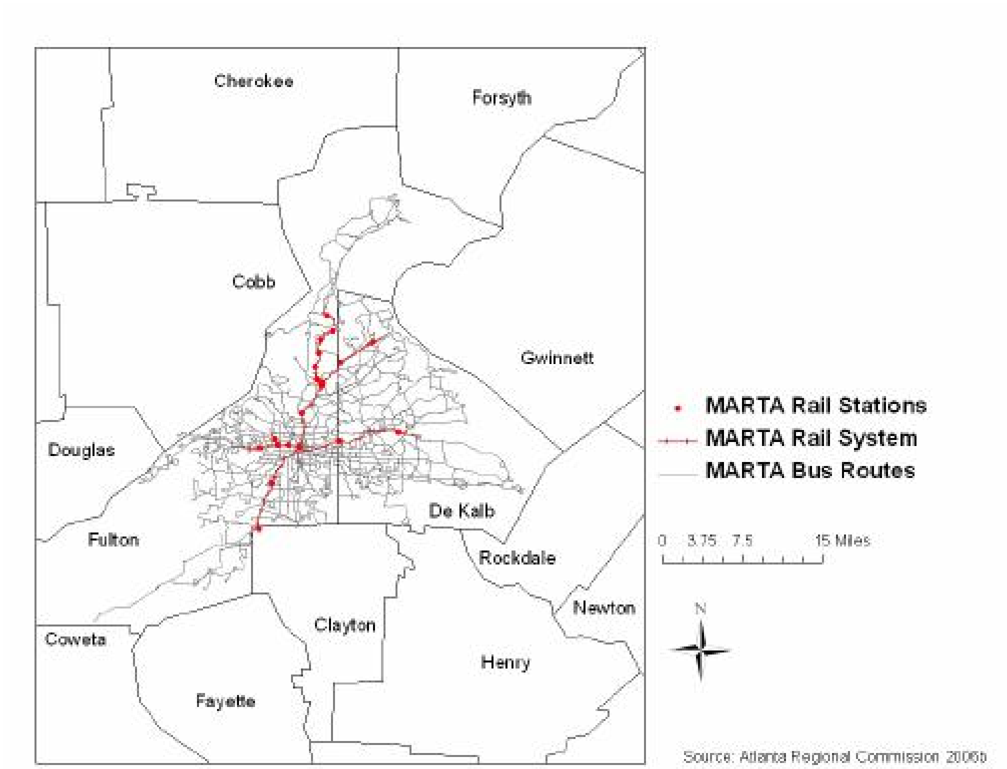


Figure 38 MARTA transit system (2007)

MARTA operates a multidestination transit network. MARTA's bus network resembles a modified grid connected to a radial rail transit spine. MARTA's 48.6-mile radial rail spine consists of four lines that offer 10 minute peak and 15 minute off-peak weekday service. The rail system dates back to the late 1970s, although most segments have opened since the mid-1980s (see Table 25). MARTA operates more than 130 bus routes, all but one of which provides a connection to one or more MARTA rail transit stations. Only 24 out of more than 130 bus routes serve the Atlanta CBD. These routes account for 17% of total weekday vehicle miles of service and 16% of both total Saturday and total Sunday vehicle miles of service.[108]

As of June 2007, MARTA's single-ride, one-way fare is $1.75.[109] MARTA also sells multi-trip passes and multi-day passes, and has special discounted fare arrangements for senior citizens, disabled riders, school-age children, and college students and staff whose colleges and universities participate in MARTA's U-Pass program. Transfers are free between MARTA bus and rail lines and between MARTA services and service operated by other local agencies, as noted above.

Table 25 Atlanta MARTA rail segment openings since 1980

Year	Segment Length (miles)	Line	Section	Cumulative System Length (miles)
1980		System length		11.8
1981	0.5	South Line	Garnett–Five Points	12.3
1981	1.4	North Line	Five Points–North Avenue	13.7
1982	1.1	North Line	North Avenue–Arts Center	14.8
1982	1.4	South Line	West End–Garnett	16.2
1984	2.7	North Line	Arts Center–Lindbergh Center	18.9
1984	3.4	Northeast Line	Lindbergh Center–Brookhaven/Oglethorpe University	22.3
1984	2.6	South Line	Lakewood/Ft. McPherson–West End	24.9
1986	1.9	South Line	East Point–Lakewood/Ft. McPherson	26.5
1987	2.7	Northeast Line	Brookhaven/Oglethorpe University–Chambleee	29.2
1988	2.6	South Line	Airport–East Point	31.8
1992	2.0	Northeast Line	Chamblee–Doraville	33.8
1992	1.5	Proctor Creek Branch	Ashby–Bankhead	35.3
1993	3.4	East Line	Avondale–Indian Creek	38.7
1996	7.9	North Line	Lindbergh Center–Dunwoody	46.6
2000	2.0	North Line	Dunwoody–North Springs	48.6

Source: Leroy Demery, "U.S. Urban Rail Transit Lines Opened from 1980," October 18, 2005, 7.

Metropolitan Atlanta Rapid Transit Authority Ridership Profile

During the 2001 and 2002 on-board survey noted earlier, Atlanta Regional Commission also developed ridership profiles for MARTA bus and rail passengers (see Table 26). Over 22,000 MARTA bus users and just under 7,500 MARTA rail users completed the on-board survey.[110] The key insight from the survey is that MARTA bus and MARTA rail patrons are indeed different. MARTA bus patrons are more likely to be female, have no automobile available, and have lower incomes than MARTA rail patrons. In short, bus patrons are more likely to be transit dependent while rail patrons include a larger percentage of choice riders. One of the interviewees observed that the poorer service quality of bus transit relative to rail transit may explain this pattern.

Table 26 Demographics of MARTA transit riders

Survey Category	Response	MARTA Bus		MARTA Rail	
		Weekday Percent	Weekend Percent	Weekday Percent	Weekend Percent
Gender	Male	47	51	50	58
	Female	53	49	50	42
Vehicle Availability	Yes	22	21	59	45
	No	78	79	41	55
Income	$0 to $29,999	66	58	42	51
	$30,000 to $59,999	25	28	26	27
	$60,000 to $99,999	8	13	19	13
	$100,000 or more	2	0	13	8

Source: Atlanta Regional Commission, "Regional On-Board Transit Survey 2001–2002," 42, 49, 53, 64, 70, 74.

ANALYSIS

Regional Transit Vision

The study's interviews indicated that the Atlanta metropolitan area is in the midst of developing a regional vision for transit.[111] Much of this discussion is being carried out under the auspices of the Transit Planning Board (TPB) which includes membership appointed by elected officials in 10 counties, the Georgia Department of Transportation (GDOT), the Georgia Regional Transportation Authority (GRTA), MARTA, the Mayor of Atlanta, and the governor of Georgia. The TPB's mission is to develop an unconstrained regional transit plan, identify funding mechanisms to pay for the plan, and coordinate (and potentially) reorganize the transit institutional and agency landscape in Atlanta.

The authors' interview contacts pointed to past tensions in the relationships of the various actors, particularly over the relative roles of state versus local and regional actors in decisionmaking. For example, the relationship between GRTA and MARTA has been a particularly difficult one. GRTA is represented on the MARTA board, but MARTA is not represented on the GRTA board. GRTA has the responsibility for approving the Transit Improvement Program (TIP) proposed by MARTA. GRTA largely reflects the interests of the state government and suburban jurisdictions (and their residents), while MARTA largely reflects the interests of the inner core urban jurisdictions (and their residents). Some tension between the organizations is perhaps inevitable given the differences in their constituencies. Because all these actors are represented on the TPB, it could potentially serve as a venue in which these tensions are reduced-assuming that all the represented parties take an active role in its deliberations. The regional visioning process being carried out under TPB began only in the past couple years and is ongoing.

While there is as yet no official regional transit vision, different agencies and stakeholder groups have expressed their own visions for transit in the Atlanta area. As part of the process of extending the one-cent local option sales tax that supports its capital and operating expenditures, MARTA proposed a series of new capital investments, including a combination of bus and rail projects. Specific projects include a rail connection to the Center for Disease Control/Emory University area, a bus rapid transit-based extension of its west rail line, a busway with on-line stations linking the Atlanta CBD area to a major shopping center in DeKalb County (Stonecrest Mall), and a beltline light rail transit loop in the center of the metropolitan area. ARC has articulated its own vision that places a significant emphasis on the use of long distance, high speed, point-to-point services, including express buses between suburban areas and the CBD, combined bus rapid transit/highway high occupancy vehicle (HOV) lane projects, and non-highway bus rapid transit (BRT).

One large joint GRTA/GDOT project that fits in with the ARC vision is a $4 billion combined BRT/HOV project in the Interstate 75 corridor running into Cobb County. The project features an elevated BRT/HOV structure and on-line, rail-like stations. The BRT services using this facility would connect to MARTA rail transit stations, and would function similar to express bus park-and-ride service. The project also includes a total of between four and six additional general purpose travel lanes in each direction. The transit portion of project cost is $1 billion and the highway portion is $3 billion. One of the interviewees noted that the original alternatives analysis for the project favored LRT over BRT as the transit component, and he is unsure why or how the decision emerged to favor BRT instead of LRT. There is presently a great deal of frustration in the region about the enormous cost of this project.

Given the Atlanta area's air quality problems and earlier federal threats to withhold the metropolitan area's federal transportation funding because of these problems, one might view this project as an example of using the guise of a transit investment as a means of achieving a desired highway capacity expansion. Indeed, most of the Atlanta area's proposals for new fixed guideway transit, with the notable exception of the MARTA Beltline LRT proposal, are located in or parallel to Interstate highway rights of way. Of course, these are also locations where significant employment and other destinations are located.

GRTA's regional vision has evolved from a one-time focus on regional commuter rail to its present focus on express buses. GRTA now articulates a regional vision based on the importance of a one-seat ride, and its express bus services are designed to provide just such a ride for its patrons. GRTA planners have sought to eliminate the need for patrons to transfer, because they believe patrons do not want to transfer. As an example of this philosophy, one of the study's interviewees pointed to the example of a high performing express bus route that formerly ran from the northern suburbs to a northern MARTA rail station that has since been realigned to run into the Atlanta CBD-in order to allow patrons to reach the CBD without transferring from bus to rail. GRTA's belief in the importance of providing door-to-door rides into the CBD has led to conflicts with the city of Atlanta which has sought to remove buses from downtown streets. Indeed, the removal of buses from CBD streets was one of the rationales for development of the rail system. Interestingly, the recent proliferation of GRTA express services has contributed to reduced utilization of parking spaces at many MARTA rail station park and ride lots, as the GRTA express buses serve as competitors to MARTA's park and ride based rail service.

The private sector has also expressed its own preferences for the region's transit vision. The business community played an active role in the original development of the MARTA rail system, and it has begun to play an active role in contemporary developments. The Metro Atlanta Chamber of Commerce is funding an update of an earlier regional commuter rail plan that was shelved in favor of an emphasis on bus rapid transit. The business community has also expressed interest in deploying more express buses to serve both CBD and non-CBD locations and in using more freeway-based rapid transit, which they have dubbed Flex Trolleys, to provide faster, premium service to major travel destinations. One contact characterized GRTA's long-distance express bus system as having emerged from the discussions about Flex Trolleys.

The authors' assessment is that Atlanta's regional vision for transit is changing. During the period leading to MARTA's creation, the regional vision involved bringing suburbanites to the Atlanta CBD to shop and to work, as part of a strategy to maintain the CBD's dominant economic position in the metropolitan area. This vision changed as the local political leadership changed from suburban and CBD interests to representatives of the center city community. At that time, much of the suburban interest in transit evaporated. The new vision, confined to the counties included in MARTA's service area, focused on the development of rail transit as a way to improve overall transit productivity by eliminating low-capacity buses and replacing them with high-capacity trains.

This vision stayed in place until around 2000, when increasing political interest in developing a regional transit vision encompassing a wider area of the Atlanta metropolitan area, far beyond the confines of MARTA's service area, began to emerge. This new vision is manifest in the desire to operate express bus service from distant suburbs to the Atlanta CBD. The authors sense that the discussion about a regional transit vision is ongoing, as evidenced by the creation of the Transit Planning Board, and is likely to evolve yet again.

Regional Transit System Structure and Function

The regional transit map shown in Figure 37 and the MARTA system map shown in Figure 38 illustrate the structure of regional transit in the Atlanta region. Essentially, the only regional (long distance) services are the express bus services that GRTA operates from the suburbs to the Atlanta CBD. These services by and large do not functionally relate to other transit services in the region. The study's interviewees observed that the various agencies tend to operate independently and have neither conceptualized nor marketed regional transit services. The suburban operators are largely (though not all of them entirely) focused on funneling riders into the core area and Atlanta CBD in the morning and back out to the suburbs in the evening. Their schedules and route structures reflect this focus, and make it difficult (although not quite impossible) for riders to use their services in the reverse direction.

If one defines the region more narrowly to include just the MARTA service area, a transit system whose components do relate to one another can be identified. MARTA staff characterizes MARTA's bus system as largely a rail feeder system, which is not surprising given that nearly all their bus routes serve one or more rail stations. The rail stations serve as transfer points for bus-to-rail, rail-to-bus, and bus-to-bus transfers. The rail system thus serves as a collector and distributor for the bus service.

When MARTA built its rail system, it restructured its buses to serve a feeder function. MARTA truncated many of its CBD-serving bus routes at rail stations. They did so in order to make the system more efficient and remove buses from CBD streets. MARTA then made sure to provide high-frequency service so as to minimize wait times for people seeking to make transfers at the stations. The interviewees noted that when buses were restructured as rail feeders there was no real thinking that doing so would also permit people to connect from one bus to another to make suburb-to-suburb trips, although they observed that such trips are indeed occurring. MARTA is currently engaged in a bus system redesign study.

Transfers

The various agencies in the Atlanta metropolitan area have very different attitudes about the necessity or desirability of transfers. As noted earlier, GRTA views transfers as a bad thing, and has planned its services so as to avoid the need for transfers. As a consequence, most of its service initiatives are planned to offer one-seat rides from distant suburbs to the Atlanta CBD. The MPO takes a similar view that transfers are undesirable, because of the perceived burden they impose on transit patrons. Operators in the region do not charge patrons for transfers, because of their desire to reduce the burdensome nature of transfers. MARTA, on the other hand, has structured its system so that transfers are necessary to reach a wide array of travel destinations. In order to minimize wait time for people making transfers, it tries to operate high frequency services, so as to make the transfer experience an easy and seamless one.

Interviews and email communications with local planners indicate that there is significant transfer activity occurring within the MARTA system and between the smaller operators and MARTA. The study's interviews revealed that there is transferring between MARTA and GCT, CCT, and CTRAN bus services, and that the activity is occurring in both directions. One interviewee noted that there is a rough balance between the numbers of suburban residents coming into the core of the region on public transit and core area residents heading out to suburban destinations on public transit. The same interviewee observed that on local suburban operator bus routes that connect to MARTA rail stations the buses are full in both travel directions at the same time. Many of these riders are undoubtedly transferring to or from MARTA services and other operators' services to complete their trip.

Transfer data are available for MARTA's services. Interestingly, ARC and MARTA have very different estimates of the amount of transfer activity that is taking place on the MARTA system. The authors also calculated their own estimates of MARTA's transfer rate, using data supplied by MARTA and data obtained from the National Transit Database. The authors will discuss this estimate of transfer activity first.

The authors' definition of transferring is: the number of transfers that take place in a transit system in a year divided by the number of annual transit patrons. One transit patron is a person who completes a trip on transit, regardless of how many times they transfer. The resulting percentage indicates, on average, the percent of patrons who transfer.

It is possible to calculate the transfer rate with the following formula:

Transfer Rate = (unlinked passenger trips - linked passenger trips)/linked passenger trips

To illustrate the study's formula, consider the following example. Suppose three different individuals boarded a bus (three unlinked passenger trips), and then two of them transferred to another bus to complete their trip (two additional unlinked passenger trips). Thus, the authors have three individuals making three linked trips but making a total of five transit vehicle boardings (unlinked passenger trips). Their formula indicates a transfer rate of about 67%.

Using this formula, they calculated a history of MARTA transfer rates (see Table 27). Transfer rates of about 30% in the early 1970s are typical of a transit system of the time with a largely radial route structure focused on the CBD. However, as MARTA opened rail lines and truncated bus routes at rail stations, the number of transit patrons who transferred increased dramatically in several steps: 1981 (34% to 69%), 1983 (83% to 101%), and 1984 (101% to 125%). The transfer rate has fluctuated between about 99% and 130% since that time. In the late 1980s the rising rate of transferring undoubtedly reflected "forced transfers," in other words, patrons who previously had a one seat bus ride from the suburbs to the CBD suddenly being forced to transfer from a feeder bus to a rail line, and perhaps having to transfer a second time from the rail line to their final destination in the CBD. Over time, however, as the authors argue elsewhere in this paper, MARTA patrons increasingly have been using the transfer opportunities to reach major destinations that increasingly are appearing in the suburbs, destinations that they would have been unable to reach with a radial bus system.

Table 27 Author-calculated MARTA transfer rate (1972–2003)

Year	Percent Transfer Rate	Year	Percent Transfer Rate
1972	30.16	1988	106.02
1973	28.01	1989	103.12
1974	28.31	1990	99.50
1975	28.12	1991	104.85
1976	30.00	1992	107.38
1977	32.17	1993	113.62
1978	29.73	1994	113.97
1979	31.69	1995	113.92
1980	34.35	1996	114.93
1981	68.56	1997	117.44
1982	83.07	1998	109.77
1983	101.47	1999	110.84
1984	125.14	2000	114.37
1985	123.23	2001	113.42
1986	98.79	2002	130.99
1987	98.84	2003	117.84

The authors compare the history of transferring with MARTA's most recent survey of its passengers.[112] Table 27 indicates that in 2006 about 36% of MARTA's patrons did not transfer at all, about 37% transferred once, and about 23% transferred more than once. Overall, Table 27 indicates 1.95 unlinked trips for every linked trip, or an overall transfer rate of 95% according to this method. These results are roughly compatible with those in Table 26 above.

Table 28 Breakdown of MARTA linked trips

Number of Unlinked Trips	Percent of patrons Making This Number of Unlinked Trips to Complete Their Journey
1	36.20
2	37.60
3	21.20
4	5.00
5	0.10

Source: MARTA Transit Research & Analysis, "Systemwide Factors and Free Intermodal Analysis for National Transit Database Reporting for Fiscal Year 2006," August 2006, 18.

The Atlanta Regional Commission, on the other hand, estimates a transfer rate from their own on-board passenger survey conducted in 2002 pursuant to TRCP standards, and their method indicates a much lower rate of transferring, in the range of 20%.[113] The final report for the survey concludes:

> Most passengers are able to get to their final destination by not having to transfer from or to another bus or train. Convenience of being able to

> get to their final destination is usually cited as a reason for using public transit and if a transit system is able to minimize the need for passenger transfers the better off the passenger is. However, the major challenge is for the transit system to efficiently (both in operating and in geographic coverage) provide service. Overall, during the week and weekend, nearly six-in-ten sampled passengers access public transit by walking. Bus access is dominated by walk mode. By nature of the rail system (and its use by commuters), nearly one-in-three access MARTA's rail system by driving a car and parking. Overall, nearly two-in-ten accessed their sampled bus trip by transferring from another bus or MARTA rail. Nearly 80 percent of passengers can get to their final destination by not having to transfer to another bus or the rail system. Slightly more than six-in-ten can get to their final destination by walking.[114]

The authors of this study contacted ARC's Modeling Manager, Guy Rosseau to ask about the discrepancy in transfer rates based on MARTA and ARC methods.[115] After examining the evidence, Mr. Rosseau concluded that the conclusion in the 2002 ARC report of survey results is in error and was based on examining the question of how many passengers in a bus or train accessed that bus or train from another bus or train. It did not consider how passengers might egress the bus or train. Recalculating the figures in the ARC on-board survey, Mr. Rosseau concluded that 39.18% of MARTA unlinked trips transfer at least once. He added that there is no way of telling from the survey the extent of multiple transferring. Using the equation presented above, the authors recalculated the figures that Mr. Rosseau provided us to arrive at the percentage of the MARTA patrons (linked trips) who transfer at least once and arrived at a figure of 64%. Given that 38% of MARTA's patrons who transfer do so more than once, the figure of 64% of linked trips transferring at least once is consistent with an overall transfer rate of about 90%. The 90% figure is less than what the history of the relation of linked and unlinked trips indicates, but it is much closer to that figure than the conclusion in the ARC final report for the 2002 onboard survey. Overall the authors conclude that MARTA experiences approximately one transfer for every patron who uses the system.

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

In the Atlanta metropolitan area, overall transit ridership growth has not kept pace with rapid population growth. The result, shown in Figure 39, is a decline in riding habit (passenger miles per capita) from 1984 to 2004. The authors examined the period from 1984–2004 because these were the earliest and most recent years, respectively, for which they could obtain passenger mile data at the time they collected these data from the National Transit Database. Overlaid on the chart are important events that could affect transit ridership, including fare increases, rail system extensions, and bus system restructuring.

An earlier statistical analysis conducted by the authors indicated that there has been a secular decline of about 5% per year in MARTA's transit ridership due to employment decentralization outside its service area, but that MARTA had reduced that downward trend to about 3% per year by serving decentralized employment inside its service area.[116] The same analysis suggested that MARTA might further reduce this decline by serving decentralized employment beyond its service area (as shown in Figure 36).

Transit service productivity in the Atlanta metropolitan area has been remarkably stable at a time when national trends indicate ever-decreasing service productivity. The authors graph service productivity over time in Atlanta in Figure 40. The study's measure of productivity is load factor, the ratio of passenger miles to vehicle miles. Essentially, load factor can be interpreted as the average number of persons on a transit vehicle. Between 1984 and 2004, load factor declined less than 1%. This indicates that the transit operators in the Atlanta metropolitan area, particularly MARTA, have been very effective at maintaining high productivity transit routes and minimizing the number of low productivity transit routes that they operate. It appears that MARTA's strategy of using rail to replace bus routes and its restructuring of remaining bus routes to feed the rail system is working.

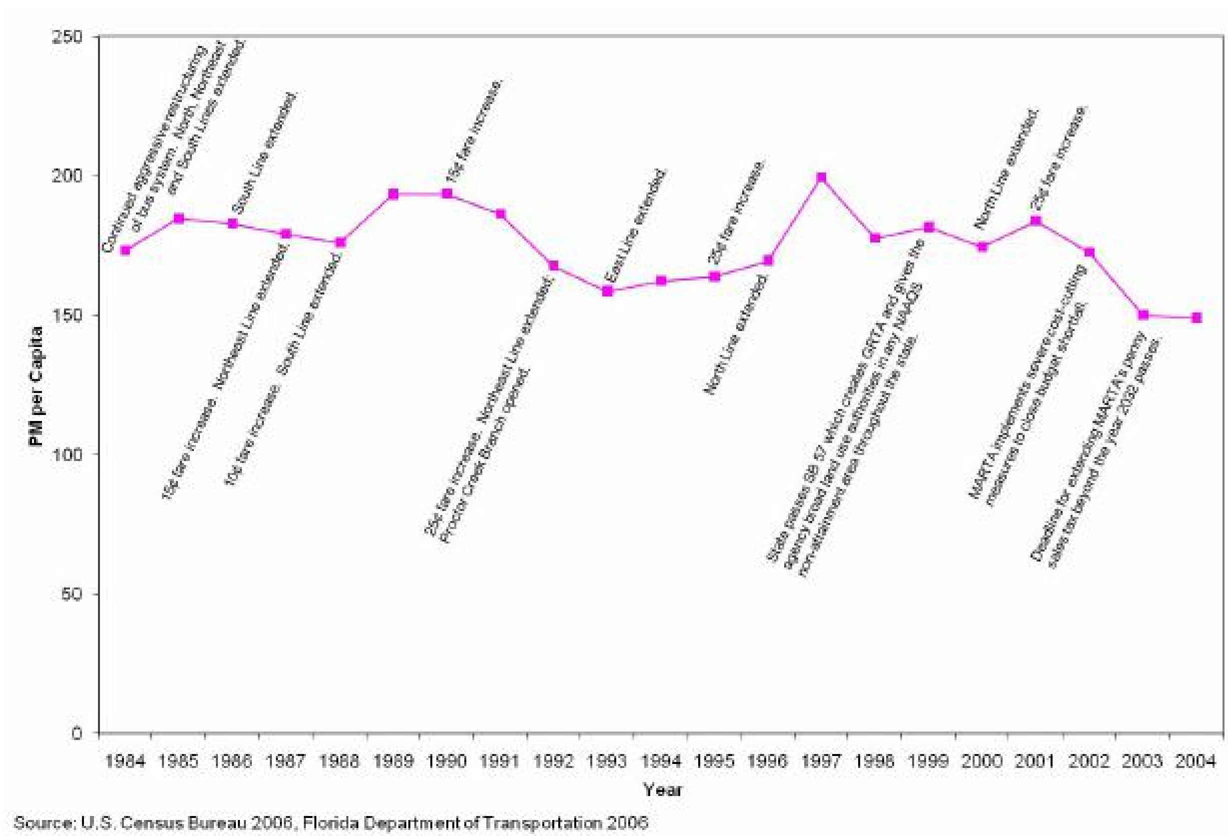
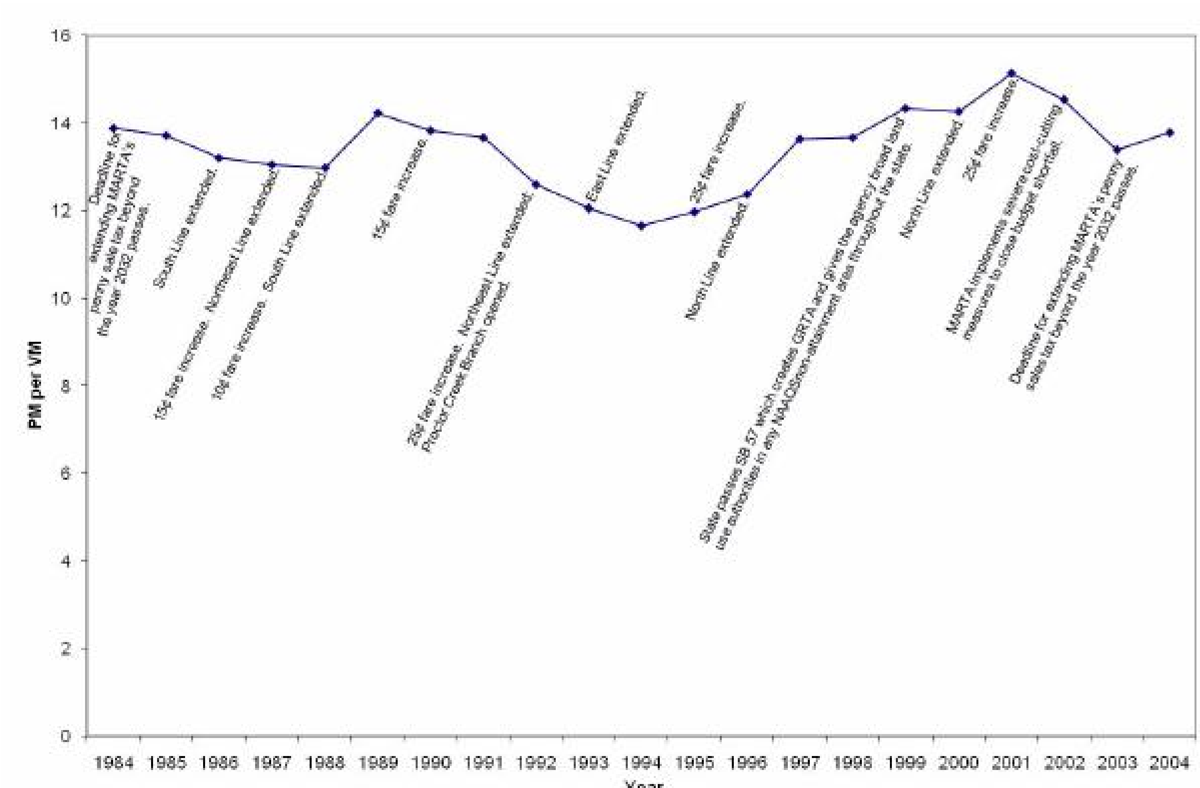


Figure 39 Atlanta MSA riding habit (passenger miles per capita) (1984–2004)

MARTA System Ridership and Productivity Trends

Table 28 reports MARTA transit ridership (by mode and system total) from 1972 to 2004 using two different measures of transit ridership: passenger miles and unlinked passenger trips (or boardings). Passenger mile data are available since 1984, while unlinked passenger trip data are since 1972, the year MARTA purchased the Atlanta Transit System (ATS) bus system.



Source: Florida Department of Transportation 2006

Figure 40 Atlanta MSA load factor (passenger miles per vehicle mile) (1984–2004)

Table 29 Ridership on MARTA fixed-route transit services (1972–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	MARTA Bus	MARTA Rail	MARTA Total	MARTA Bus	MARTA Rail	MARTA Total
1972				59,627,000		59,627,000
1973				66,157,000		66,157.000
1974				72,310,000		72,310,000
1975				74,287,000		74,287,000
1976				77,360,000		77,360,000
1977				79,016,000		79,016,000
1978				79,944,000		79,994,000
1979				86,005,000	19,000	83,024,000
1980				86,874,000	12,138,000	99,012,000
1981				84,510,000	21,138,00	105,622,000
1982				84,275,000	21,231,000	105,506,000
1983				81,909,000	37,545,000	119,454,000
1984	328,049,720	159,045,390	487,095,110	91,634,000	49,427,000	141,061,000
1985	315,325,249	222,418,583	537,743,832	98,048,000	57,688,000	155,736,000
1986	270,821,796	279,785,998	550,607,794	85,257,000	65,548,000	150,805,000
1987	271,593,074	285,216,559	556,809,633	83,804,984	66,098,000	149,902,984
1988	269,322,510	292,850,099	562,172,609	82,309,577	65,908,000	148,217,577
1989	272,637,747	359,269,756	631,907,503	79,801,299	65,603,000	145,404,299
1990	272,290,605	360,042,125	632,332,730	78,898,381	68,947,000	147,845,381
1991	272,849,957	349,648,696	622,498,653	76,031,138	67,117,000	143,148,138
1992	239,362,143	334,399,781	573,761,924	76,934,710	64,078,000	141,012,710
1993	222,981,973	336,388,106	559,370,079	73,020,991	65,005,000	138,025,991
1994	212,843,021	378,370,443	591,213,464	72,837,000	69,855,000	142,692,000
1995	220,548,489	397,366,936	617,915,425	73,253,000	70,351,000	143,604,000
1996	221,130,516	437,886,183	659,016,699	72,295,000	72,434,000	144,729,000
1997	263,356,670	547,885,672	811,242,342	79,231,000	90,991,000	170,222,000
1998	255,193,100	488,747,655	743,940,755	80,301,000	77,802,000	158,103,000
1999	312,619,729	476,175,405	788,795,134	83,253,891	80,398,088	163,651,979
2000	273,115,776	503,490,135	776,605,911	83,118,954	83,796,606	166,915,560
2001	284,492,107	563,016,836	847,508.943	81,497,127	82,388,642	163,885,769
2002	304,108,779	510,361,624	814,470,403	76,805,808	82,339,493	159,145,301
2003	234,557,154	487,349,350	721,906,504	70,641,397	71,859,591	142,500,988
2004	277,747,016	455,358,663	733,105,679	66,761,993	69,088,589	135,850,591

Sources: Florida Department of Transportation, 2006; Metropolitan Atlanta Rapid Transit Authority, 2006a.

The right side of the table indicates that unlinked passenger trips increased significantly during the 1970s and early 1980s. This was a time when bus service was expanded and the first segments of the rail system began to open. From the mid-1980s to mid-1990s, unlinked passenger trips were stagnant, but passenger miles increased steadily. This is a reflection of increasing average trip lengths (as shown in Table 30) as the various segments of the MARTA rail system opened. Table 30 shows that while average bus trip lengths have fluctuated from year to year, there has been no trend toward either longer trips or shorter trips. Average rail trip lengths, on the other hand, have increased significantly as the rail system has been expanded.

Table 30 Average trip lengths (MARTA) (1984–2004)

Year	Average Trip Length (miles)		
	MARTA Bus	MARTA Rail	MARTA Total
1984	3.58	3.22	3.45
1985	3.22	3.86	3.45
1986	3.18	4.27	3.65
1987	3.24	4.32	3.71
1988	3.27	4.44	3.79
1989	3.42	5.48	4.35
1990	3.45	5.22	4.28
1991	3.59	5.21	4.35
1992	3.11	5.22	4.07
1993	3.05	5.17	4.05
1994	2.92	5.42	4.14
1995	3.01	5.65	4.30
1996	3.06	6.05	4.55
1997	3.32	6.02	4.77
1998	3.18	6.28	4.71
1999	3.76	5.92	4.82
2000	3.29	6.01	4.65
2001	3.49	6.83	5.17
2002	3.96	6.20	5.12
2003	3.32	6.78	5.07
2004	4.16	6.59	5.40

Sources: Florida Department of Transporation, 2006; Metropolitan Atlanta Rapid Transit Authority, 2006a.

The authors' reflected on potential explanations for lengthening rail trips in an earlier study of transit ridership trends in the Atlanta metropolitan area.[117] During conversations that were held with MARTA staff for that study, the authors learned that many MARTA rail stations in northern Fulton County have become major destinations, including Buckhead, Dunwoody, Lindbergh, and Sandy Springs. Many people use the MARTA rail system to travel from residences in southern Fulton and DeKalb Counties to reach the employment and other destinations located near these stations. The interviews for this project largely reinforced this finding that people are using MARTA to travel from primarily minority communities in the south to job-rich areas in the north.

Over the past decade, MARTA ridership has experienced highs associated with the 1996 Olympics (ridership reflected in the 1997 reporting year), and the late 1990s and early 2000s economic boom. Since that time, ridership has declined, and so has service (as shown in

Table 31), perhaps as a consequence of the economic downturn. The study's interviewees indicate that ridership has begun to increase once again.

MARTA is dependent on a one-cent county-based local option sales tax to finance the local share of both capital and operating expenses. Because of this, the amount of service MARTA supplies tends to reflect the overall health of the local economy. In recent years, MARTA has faced flat or declining service levels, and the agency has had to make tradeoffs between providing more extensive geographic coverage or providing more frequent service in established parts of the system. The interviews also indicated that MARTA and GRTA have discontinued their shuttle bus services in outer areas because of the current tight fiscal environment.

One coping strategy would be for the region to find a new finance instrument. The state of Georgia has a constitutional amendment prohibiting expenditure of gasoline tax revenues on transit, so that mechanism is not feasible unless the political environment changed considerably in the state. Another alternative would be a broader sales tax. interviews indicated that significant local leadership and business community support would be needed to implement a regional sales tax, as either a substitute to or complement to the one cent sales taxes in Fulton and DeKalb Counties.

While MARTA's service has stagnated or declined in recent years, overall service productivity, measured in terms of load factor, has been remarkably stable. Table 32 shows that while MARTA's service productivity has fluctuated between 1984 and 2004, its 2004 productivity was nearly identical to its productivity in 1984. This was a significant accomplishment given the national trend during that time period which was an average productivity decline of 14%.

However, the table also indicates that the system productivity numbers are a reflection of the particular mix of rail and bus services it operates at given points in time. The table shows that both bus productivity and rail productivity have declined since 1984. The decline in rail productivity may be due to the lengthening of the rail system to areas that produce fewer riders than the original core system. Bus productivity declines are reflective of larger national trends, although the decline in Atlanta is less severe than in many other metropolitan areas.

Table 31 MARTA fixed-route transit service (1972–2004)

Year	Vehicle Miles		
	MARTA Bus	MARTA Rail	MARTA Total
1972	19,236,000		19,236,000
1973	22,419,000		22,419,000
1974	24,638,000		24,638,000
1975	26,986,000		26,986,000
1976	27,203,000		27,203,000
1977	27,507,000		27,507,000
1978	28,368,000		28,368,000
1979	30,217,000	2,000	30,219,000
1980	31,833,000	2,823,000	34,656,000

Table 31 MARTA fixed-route transit service (1972–2004)

Year	Vehicle Miles		
	MARTA Bus	MARTA Rail	MARTA Total
1981	31,361,000	4,061,000	35,422,000
1982	30,294,000	3,950,000	34,244,000
1983	28,945,000	4,942,000	33,887,000
1984	28,937,325	6,143,853	35,081,178
1985	29,144,355	10,037,589	39,181,944
1986	29,541,225	12,156,493	41,697,718
1987	30,109,041	12,549,790	42,658,831
1988	29,814,357	13,493,884	43,308,241
1989	29,611,460	14,795,429	44,406,889
1990	29,383,760	15,810,010	45,193,770
1991	29,177,032	16,055,617	45,232,649
1992	29,082,151	16,316,854	45,399,005
1993	28,824,588	17,482,878	46,307,466
1994	29,126,347	21,519,878	50,646,255
1995	29,145,946	22,341,905	51,487,851
1996	30,185,472	23,065,397	53,250,869
1997	31,042,079	27,785,616	58,827,695
1998	30,807,362	22,994,085	53,801,447
1999	31,140,890	23,083,795	54,224,685
2000	31,852,916	22,210,105	54,063,021
2001	32,041,690	23,239,656	55,281,346
2002	31,310,182	24,221,206	55,531,388
2003	30,196,985	23,509,754	53,706,739
2004	29,990,751	22,791,083	52,781,834

Sources: Florida Department of Transportation, 2006; Metropolitan Atlanta Rapid Transit Authority 2006a.

Table 32 MARTA service productivity (1984–2004)

Year	MARTA Bus	MARTA Rail	MARTA Total
1984	11.34	25.89	13.88
1985	10.82	22.16	13.72
1986	9.17	23.02	13.20
1987	9.02	22.73	13.05
1988	9.03	21.70	12.98
1989	9.21	24.28	14.23
1990	9.27	22.77	13.99
1991	9.35	21.78	13.76
1992	8.23	20.49	12.64
1993	7.74	19.24	12.08
1994	7.31	17.58	11.67
1995	7.57	17.79	12.00

Table 32 MARTA service productivity (1984–2004)

Year	MARTA Bus	MARTA Rail	MARTA Total
1996	7.33	18.98	12.38
1997	8.48	19.72	13.79
1998	8.28	21.26	13.83
1999	10.04	20.63	14.55
2000	8.57	22.67	14.36
2001	8.88	24.23	15.33
2002	9.71	21.07	14.67
2003	7.77	20.73	13.44
2004	9.26	19.98	13.89

Sources: Florida Department of Transportation, 2006; Metropolitan Atlanta Rapid Transit Authority 2006a.

Bus Route Performance Analysis

In an attempt to better understand which kinds of services and markets are growing and which ones are declining, the authors obtained individual route ridership and service statistics for all MARTA bus routes.[118] Available ridership data included average weekday, Saturday, and Sunday unlinked passenger trips; neither passenger mile nor linked passenger trip data were available on a route-by-route basis. Available service data included average weekday, Saturday, and Sunday revenue miles, revenue hours, vehicle miles, and vehicle hours. As measures of route-level transit performance, the authors decided to use (unlinked passenger) trips per revenue hour and (unlinked passenger) trips per revenue mile. The values for the former variable for the average weekday ranged from a low of 3.58 to a high of 55.17. The median value for weekdays was 28.70. The values for latter variable for the average weekday ranged from a low of 0.31 to a high of 8.70. The median for weekdays was 2.29 unlinked passenger trips per revenue mile.

The authors decided that an important focus of the route-based analysis should be to distinguish between routes that served the Atlanta CBD and those that do not. Compared to many other systems, MARTA has relatively little of its service focused on the Atlanta CBD: only 17% of weekday vehicle miles are allocated to routes serving the CBD.[119] To examine this issue, they classified routes based on whether the bus route served the Atlanta CBD or not. They also differentiated among the routes based on whether they provided all-day service or not. Table 33 reports the median values for the resulting groups of routes, for weekdays, Saturdays, and Sundays.

Among all transit routes, the median CBD-serving route performed better than the median non-CBD-serving route on weekday trips per revenue hour and per revenue mile, on Saturday trips per revenue hour and per revenue mile, and on Sunday trips per revenue mile. Interestingly, the median non-CBD-serving route outperformed its CBD-serving counterpart on Sunday trips per revenue hour. The median all-day route tended to perform better than the median of the set of all routes within each of these groups. This latter result was expected, given the particular performance measure that were employed: passenger trips per revenue mile. The non-all-day service routes, of which there are eight routes, are peak-only services that tend to carry long distance patrons; thus, the density of trips per revenue mile will tend to be lower than for other kinds of services. An alternative measure of route productivity would be load factor (passenger miles per vehicle mile), but passenger miles data were unavailable on a route-by-route basis.

Table 33 MARTA bus route performance

Route Type	Routes	Trips per Revenue Hour (median)			Trips per Revenue Mile (median)		
		Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
All routes	132	28.70	24.49	21.05	2.29	1.99	1.61
CBD-serving routes	24	29.05	25.07	18.71	2.62	2.03	1.92
Non-CBD routes (all routes)	108	28.62	23.49	21.58	2.21	1.99	1.58
CBD-serving routes (all day routes only)	23	24.53	25.07	18.71	2.65	2.03	1.92
Non-CBD routes (all day routes only)	101	29.56	23.49	21.58	2.34	1.99	1.58

Sources: Florida Department of Transportation, 2006; Metropolitan Atlanta Rapid Transit Authority 2006a.

Many of the MARTA bus routes that serve the Atlanta CBD also serve MARTA rail stations and important travel destinations outside the CBD, so it is possible that many of the passengers on these routes are boarding and alighting outside the CBD. Four of the top five performing CBD-serving routes serve non-CBD MARTA rail stations. Stop-based boarding and alighting data for each route would be required to make a more specific determination about passenger origins and destinations, but such data were not available for MARTA's bus routes. The bottom-line conclusion is that there is very little difference in the productivity of CBD-serving versus non-CBD bus routes.

Rail Station Entries

Figure 41 provides a map of average daily station entries by MARTA rail station during 2006–2007. The figure shows that station entries at some non-CBD stations are just as large as those at CBD stations. The figure also shows that there is much more activity on the north-south segments of the system than on the east-west line. This is not surprising given the maps of population and employment density shown in Figure 34 and Figure 36. These maps indicated that employment density, in particular, is much lower in this corridor than in the north-south corridor.

On the north-south lines, there is boarding activity at a number of stations. The stations at Doraville, Chamblee, North Springs, and Dunwoody are visible at the northern ends of the MARTA rail line. These northern stations are connection points for MARTA bus routes and major employment centers in their own rights. Further south, the major activity centers at the

Lenox, Lindbergh Center, and Arts Center stations generate significant rail boardings, as do the stations in the Midtown and CBD areas. All of these stations are destination stations with significant employment activity. Between the CBD and the airport, the station entries largely reflect poorer persons entering the system to access destinations in other locations. The east-west line features much less activity. Outside the CBD, the most heavily used stations are the H.E. Holmes station to the west and the Kensington station to the east.

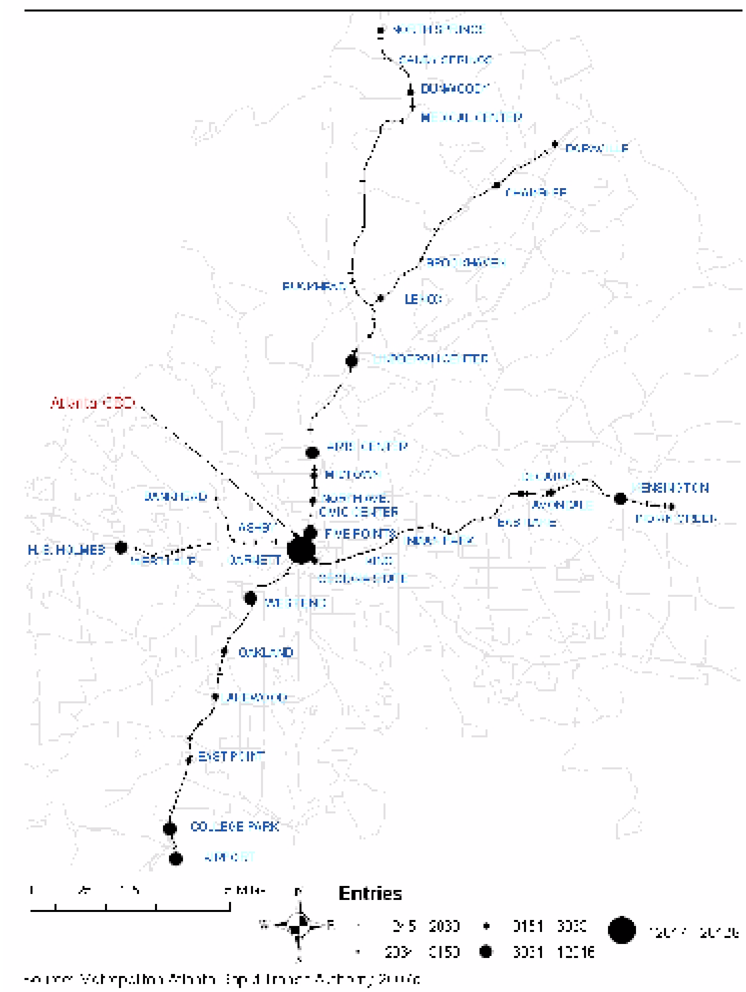


Figure 41 MARTA average daily rail station entries (2006–2007)

Emerging and Declining Ridership Markets

The study's interviews allowed us to identify several ridership markets where MARTA is experiencing growing ridership and several other markets where ridership is stagnant or declining. MARTA's system ridership is now fairly balanced by time of day and has strong ridership in the reverse commute direction. Passenger loads tend to be balanced by time of day and direction on rail lines and on many bus routes as well. GRTA, on the other hand, serves more traditional directional (and time of day) ridership patterns. The other local operators are carrying many reverse commute trips, but the interviewees contend that the agencies don't fully recognize or appreciate this travel market.

The study's interviewees pointed to the reverse commute market as an increasingly important one that MARTA is tapping but that the other operators have largely ignored. Employment decentralization, population decentralization, and immigration have changed the metropolitan landscape leading to increasingly complex, non-traditional travel patterns. One non-traditional travel pattern noted earlier is people traveling from southern parts of the region through the Atlanta CBD and north to suburban jobs.

As noted earlier, many MARTA rail stations, particularly in the northern part of the system, lie at major hubs of activity. Areas around the Buckhead and Lindbergh stations and around the Perimeter Mall have become major activity centers, and thus important travel destinations. According to the contacts, many riders are using transit to access these destinations. In the Perimeter Mall area, employers are running shuttles to the rail stations. In the Buckhead/Lennox Area, many people are utilizing rail, local bus routes, and the Buck shuttle to reach destinations. All of these represent growing ridership markets. MARTA is also reporting new ridership as a result of people transferring from jitney services to MARTA bus and rail stations in corridors like the Buford Highway into Gwinnett County. Finally, MARTA is also seeing increased ridership by people traveling from the northern part of the metropolitan area to the airport who use the MARTA rail station park and ride lots as airport parking and the MARTA rail system as, essentially, an airport parking shuttle.

MARTA also has declining ridership markets. The study's interviewees noted that MARTA is losing very long distance commuters who would generally use park and ride lots as access points to the MARTA rail system to services like GRTA's express buses. However, given the low levels of ridership on GRTA express bus routes, some additional factors must also explain this change. One possible explanation is the declining importance of the Atlanta CBD as a travel destination. MARTA's rail patronage now tends to be more dominated by people traveling inside the MARTA service area to access non-CBD employment and other destinations.

One of the interviewees noted that MARTA is struggling to continue to attract choice riders. One of MARTA's strategies for attracting choice riders is to develop special services to serve specific markets. The Blue Flyer commuter-oriented service and the Peach, a local bus route that operates up and down Peachtree Street, are two initiatives that MARTA has implemented, at least in part, to attract more choice riders. According to the interviewees, the Peach has been successful at attracting choice riders.

Transit and Development

The link between transit and development has been an important one in the Atlanta area. One of the rationales for the development of the MARTA rail system was to protect the CBD's status as the economic focal point of the Atlanta area. More recently, rail transit stations have been used as important focal points for transit-oriented development (TOD).

The study's interviewees observed that rail transit had not affected development in the region very much until recently, when the region began to embrace transit-oriented development. Most Atlanta TODs are residential, particularly those in outer areas. Closer-in rail stations tend to have more office development activity as part of the mix of development in the surrounding area. At the Lindbergh station TOD, there is a combination of residential and commercial activity. At the Chamblee station, parking lots are being converted to residential and retail development. The public sector is playing a major role in promoting TOD.

In some areas, rail is being used as a revitalization tool. The first segment of the proposed beltline LRT project noted earlier will be built in a depressed area in the southwest quadrant of the loop, in order, officials hope, to stimulate development activity in the area. They decided to build the northeast quadrant later, although there is significant existing activity in this area, and presumably an existing market for the new service to be provided by the LRT. The interviewees also noted that the beltline will take advantage of a trend toward the gentrification of single-family homes in the inner city, presumably because this trend could be leveraged to promote redevelopment and/or to generate transit patronage.

The interviewees stated the TOD and transit-related redevelopment projects have generated transit patronage for MARTA, although there have been no systematic studies of this issue by MARTA or any of the other agencies in the Atlanta area.

Public Attitude toward Transit

The study's interviewees noted that the public attitude to transit in the Atlanta area is more positive, and that the public has demonstrated more willingness to support transit. The recent extensions of the MARTA sales tax are cited as evidence of the former proposition. One interviewee observed that ever-increasing traffic congestion is creating more of a desire for transit outside the core of the region, but not much of a desire to extend MARTA beyond its present service area boundaries. Indeed, the MARTA contacts don't see plans to extend MARTA's service in the near-term.

One reason for the lack of enthusiasm for extending MARTA is the area's history of racial politics. During the development of the rail system, the other three core area counties (Cobb, Clayton, and Gwinnett) decided not to join MARTA, for reasons that most observers have attributed to race. MARTA has long been associated with a minority ridership image, and suburbanites are hesitant to bring its service to their communities.

Instead, suburban counties have signed on to the express bus service recently inaugurated by GRTA. Under a complicated financing scheme that is used to avoid running afoul of the state constitution's prohibition against using gasoline tax money for transit, twelve counties pay into a fund that is used to finance GRTA service. The state then trades road money for these contributions, and builds road projects with its traded funds. The GRTA fund is currently scheduled to exhaust its resources in 2010 or 2011, at which time the routes are scheduled to revert to the counties. The current GRTA director has stated that the state will continue to support the GRTA service beyond 2010 and 2011.

DISCUSSION

This study's analysis of Atlanta suggests a transit system in transition, as the region continues to struggle with the development of a regional transit vision. At present, there are two distinct service visions with very different ridership results. Inside the region's core of Fulton and DeKalb Counties, MARTA has articulated and implemented a multidestination service version that serves a diverse array of travel destinations. MARTA has coordinated and integrated its bus and rail services, using the extensive bus network as a distribution system for its rail transit system, which serves as a trunk line. The analysis indicates that this service strategy is working. MARTA enjoys high ridership and high service productivity. MARTA is successfully serving the growing non-CBD-focused travel markets that are most important in this still-decentralizing region.

Outside the MARTA service area, there is a very different vision, and a very different service strategy. Individual transit agencies, informed by erroneous data on transfer rates and other aspects of travel behavior, have implemented service strategies focused on feeding people into the center of Atlanta, in the peak direction only. The services provided by GRTA, CCT, and GCT are not well coordinated with one another, or with MARTA's bus services. The lack of service coordination, and the neglect of travel destinations outside the center of Atlanta, has resulted in poor ridership and low productivity on these systems. The miniscule ridership on GRTA express buses is particularly striking.

The authors' analysis suggests that the vision and service strategy being pursued outside the MARTA service area has not and will not generate significant ridership. The Atlanta metropolitan area is increasingly decentralized, and the center of Atlanta represents a diminishing share of the region's travel destinations. Every year, fewer Atlantans travel into the regional center for employment and other purposes every year, while more Atlantans seek to travel to other major activity centers outside the center. An effective regional service strategy would seek to serve the growing travel markets, as opposed to focusing solely on serving the declining one. An effective regional service strategy would extend the vision and service strategy being implemented by MARTA, inside its service area, to the metropolitan area as a whole.

Given the region's ever-increasing size and complexity, the authors believe that an overlay regional transit system is required to serve the increasing number of long-distance trips. This system would feature an inter-connected grid of routes with stations at all major destinations. A model for this type of system would be the RER in Paris or the S-Bahn in various German cities. Such a system might include regional rail (not focused predominantly on the Atlanta CBD), MARTA rail, and bus rapid transit services (not implemented as part of major freeway projects).

Figure 42 maps how such a system might be devised, while leveraging the existing MARTA bus and rail system to form its core. The figure maps the MARTA transit system on top of a map of employment density, by census tract, in the core of the region. On top of this map, the authors have sketched (in purple) a handful of high-speed regional routes that could serve as the framework for extending MARTA's multidestination service strategy to a larger geographic area. The map shows that such a strategy is not an overwhelmingly difficult one, as most employment concentrations are located in corridors as opposed to being widely dispersed. As new employment corridors emerge, new segments can be added to the regional system. These regional routes would coordinate with local services in each of the corridors.

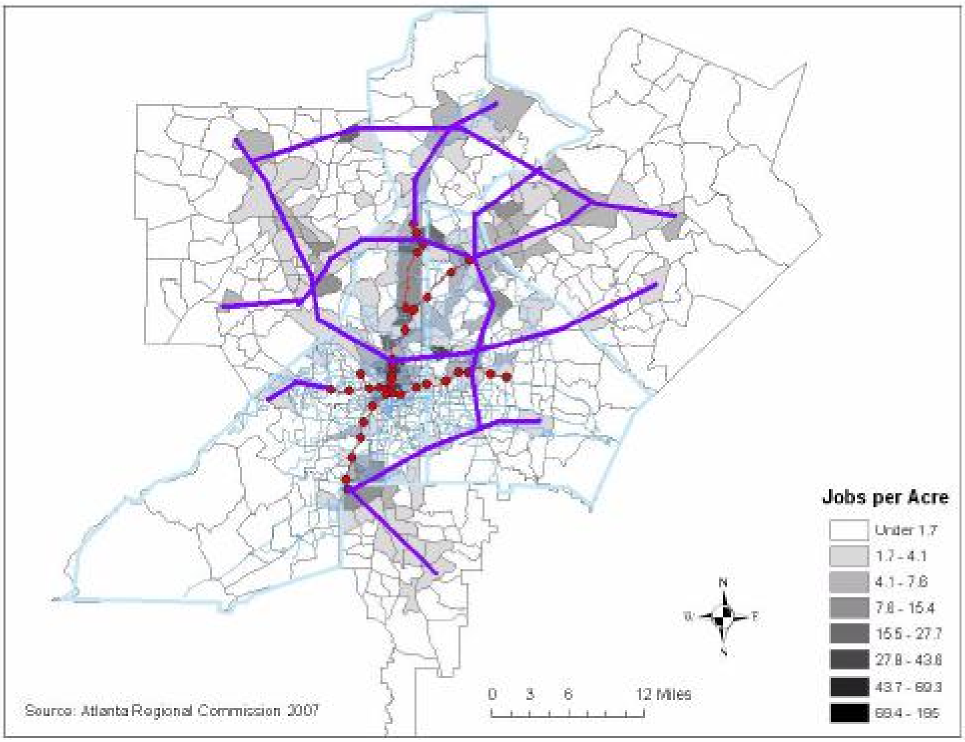


Figure 42 Hypothetical regional transit system for Atlanta and its relation to employment (2005)

This hypothetical system would be based on the integration and coordination of bus and rail services. This system would rely heavily on passenger transferring as the means of connecting a diverse array of origins and destinations. Planning such a system, and making it work, would require more accurate data about transfer activity than exists now in Atlanta. Such a system represents the logical extension of MARTA's service strategy to the region as a whole, and is likely to have the same positive effects on ridership as have MARTA's own actions.

APPENDIX B
DALLAS-FT. WORTH, TEXAS

SETTING

The Dallas-Fort Worth Metropolitan Statistical Area (MSA) consists of 12 counties in northeast Texas with a total land area of just under 9,000 square miles.[120] With 5.8 million persons in 2005, the Dallas-Fort Worth MSA ranks as the nation's fifth largest in population.[121] The MSA's population density is just under 650 persons per square mile.

Two counties represent the center of population and employment in the Dallas-Fort Worth MSA: Dallas and Tarrant. Dallas County is the location of the city of Dallas, the MSA's largest city, while Tarrant County is the location of the city of Fort Worth. The authors refer to these two counties as the MSA core counties. The primary transit agency in the region, Dallas Area Rapid Transit, focuses most of its service inside Dallas County although it also serves small portions of several suburban counties (see Figure 43).

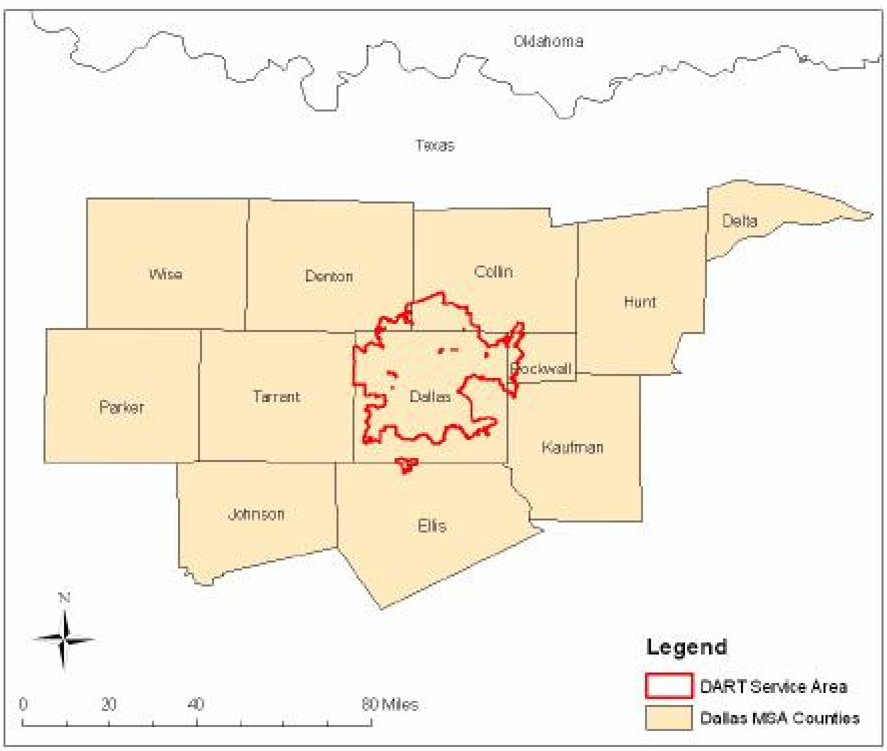


Figure 43 Dallas-Fort Worth metropolitan statistical area

Distribution of MSA Population

Dallas is a rapidly growing, and increasingly decentralized, metropolitan area. Population has decentralized considerably since 1970 (see Figure 44). This figure provides maps of population by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of population from Dallas and Tarrant counties first to the northern suburban counties of Collin and Denton and then to other counties throughout the MSA.

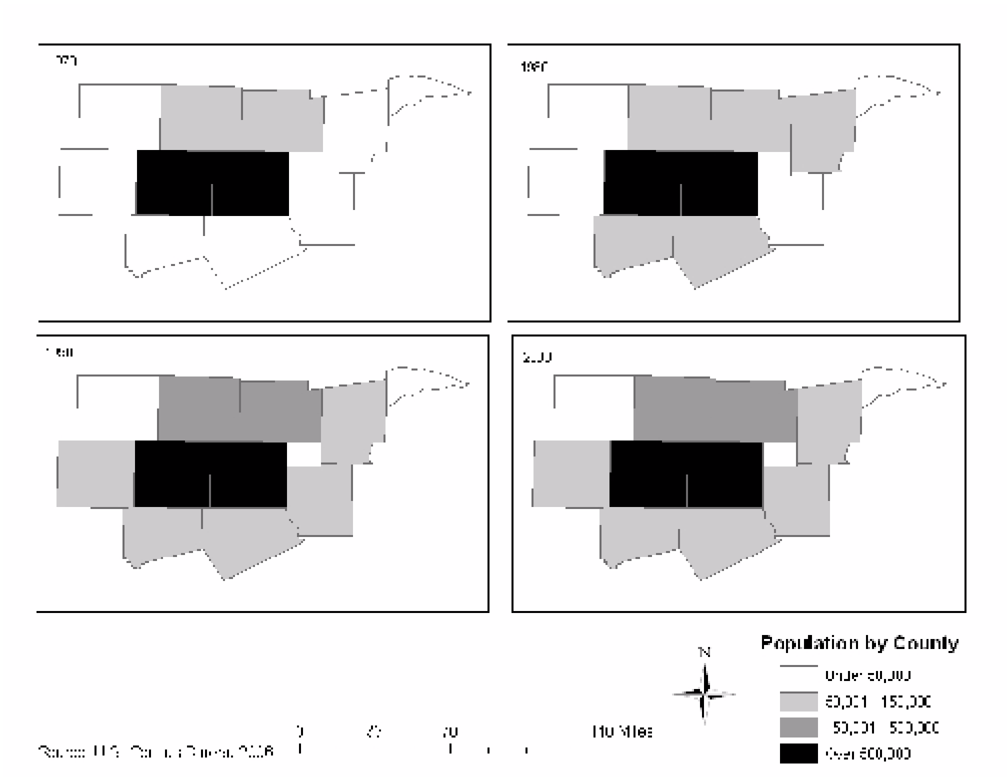


Figure 44 Dallas-Fort Worth MSA: population by county (1970–2000)

Between 1970 and 2005, total MSA population increased 140% from 2.4 million to 5.8 million persons (see Table 34). Population growth in Dallas and Tarrant counties, referred to in the table as the MSA core counties, has been much slower (92%) than in the rest of the MSA (397%). In 1970, Dallas and Tarrant counties accounted for 84% of the MSA population; today they account for around two-thirds of the MSA population. These two counties occupy about 1,750 square miles and have an average population density of 2,250 persons per square mile.[122]

The remaining ten counties occupy about 7,250 square miles and have an average population density 800 persons per square mile.[123] Of these ten counties, the only sizable populations are found in Collin and Denton counties, which are located just north of Dallas and Tarrant counties. These two counties have experienced rapid population growth, particularly since the mid-1980s, and now have a combined 1.2 million residents.

Table 34 Population in the Dallas–Fort Worth metropolitan area (1970–2005)

Year	Dallas County	MSA Core Counties (2 counties)	Other MSA Counties (10 counties)	Total MSA (12 counties)
1970	1,327,696	2,043,283	380,848	2,424,131
1971	1,351,100	2,077,500	395,700	2,473,200
1972	1,353,300	2,075,200	413,000	2,488,820
1973	1,370,400	2,097,500	444,600	4,542,100
1974	1,398,000	2,144,200	468,800	2,613,000
1975	1,426,800	2,185,800	473,700	2,659,500
1976	1,459,500	2,240,600	487,900	2,728,500
1977	1,476,500	2,270,600	509,600	2,780,200
1978	1,497,500	2,307,300	538,900	2,846,200
1979	1,522,100	2,357,200	571,800	2,929,000
1980	1,556,419	2,417,299	599,931	3,017,230
1981	1,597,905	2,493,461	630,189	3,123,650
1982	1,637,637	2,571,466	664,642	3,236,108
1983	1,678,364	2,645,772	699,726	3,345,498
1984	1,713,907	2,715,743	745,352	3,461,095
1985	1,760,803	2,804,010	796,967	3,600,977
1986	1,805,314	2,888,955	847,722	3,736,677
1987	1,816,641	2,932,751	886,670	3,819,421
1988	1,814,458	2,947,651	916,193	3,863,844
1989	1,832,113	2,981,643	914,294	3,922,937
1990	1,863,546	3,040,766	973,575	4,014,341
1991	1,906,149	3,112,036	1,002,091	4,114,127
1992	1,938,264	3,163,807	1,035,253	4,199,060
1993	1,969,978	3,213,862	1,075,773	4,289,635
1994	1,999,337	3,269,976	1,123,010	4,392,986
1995	2,032,742	3,327,195	1,173,959	4,501,154
1996	2,073,484	3,396,691	1,230,958	4,627,649
1997	2,118,835	3,474,153	1,296,267	4,770,420
1998	2,163,082	3,551,448	1,366,545	4,917,993
1999	2,197,658	3,620,030	1,439,926	5,059,956
2000	2,218,899	3,665,118	1,497,089	5,162,207
2001	2,262,154	3,750,934	1,598,761	5,349,695
2002	2,273,205	3,798,522	1,674,623	5,473,145
2003	2,281 411	3 838 593	1,746,954	5,585,493
2004	2,291,071	3,878,090	1,817,955	5,696,045
2005	2,305,454	3,925,933	1,893,542	5,819,475

Source: U.S. Census Bureau

Figure 45 maps population density by census tract in 2005 for 11 Dallas-Fort Worth MSA counties for which these data are available. The map indicates that, while population is dispersed, most population concentrations are located inside or near the boundaries of the two core counties: Dallas and Tarrant. The counties to the north of Dallas and Tarrant have sizeable population concentrations in their southern portions, while the absence of such concentrations in the southern tier of counties is also striking.

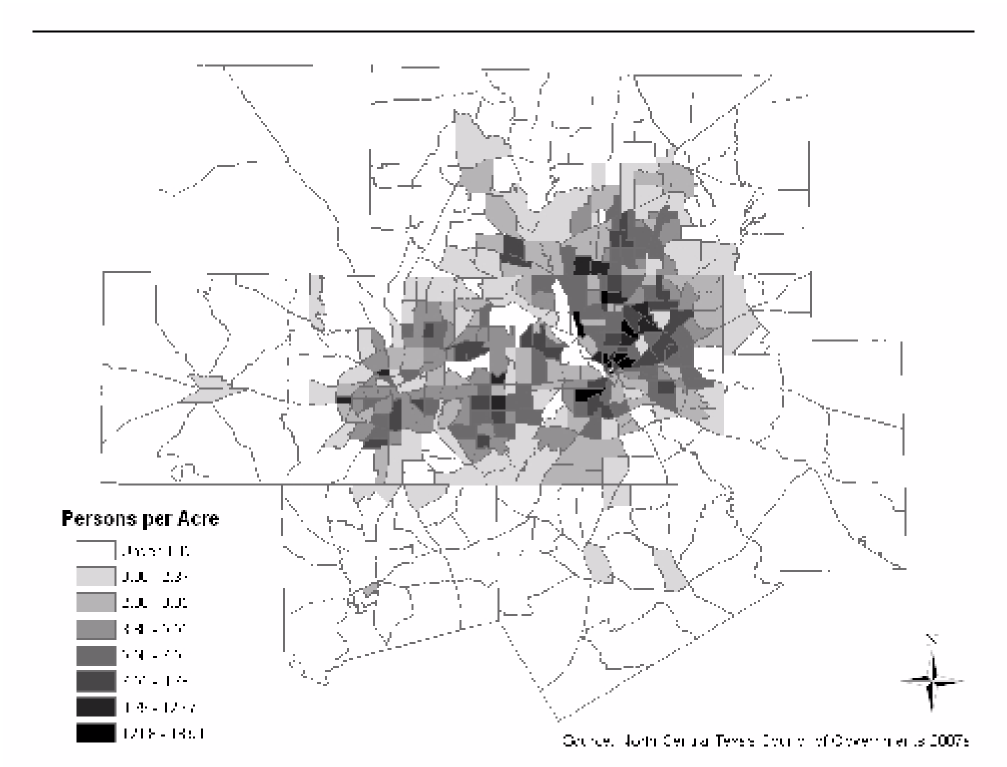


Figure 45 Dallas-Fort Worth MSA: population density by census tract (2005)

Distribution of MSA Employment

Employment has also grown and decentralized, but it remains much more concentrated than population (see Figure 46). This figure provides maps of employment by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of employment from Dallas county first to Tarrant county and then to Collin and Denton counties. The maps show very little employment in the remainder of the MSA.

Total MSA employment has increased fairly steadily since 1970. Between 1970 and 2005, total MSA employment increased 230% from 870,000 to 2.9 million jobs (see Table 35). Employment growth in the MSA core counties has been much slower (178%) than employment growth in the rest of the MSA (1,099%). In 1970, Dallas and Tarrant counties accounted for 94% of all jobs in the MSA; by 2005, they accounted for approximately 79% of all jobs in the MSA. However, most of the suburban employment decentralization has occurred to the nearby counties of Collin and Denton. In 2005, more than 94% of all jobs in the MSA are found in Dallas, Tarrant, Collin, and Denton counties.

Within Dallas County, which accounts for most of the Dallas Area Rapid Transit service area, employment has also decentralized. The Dallas central business district (CBD) has added jobs since 1970, but all of that employment growth occurred between 1970 and 1980 (see Table 35). Dallas CBD employment peaked in 1980 at 102,000 jobs. From 1980–2005, employment in the CBD declined. By contrast, employment growth in suburban portions of Dallas County has been relatively steady. The result is that the Dallas CBD represents a smaller share of MSA employment today than it did in 1970.

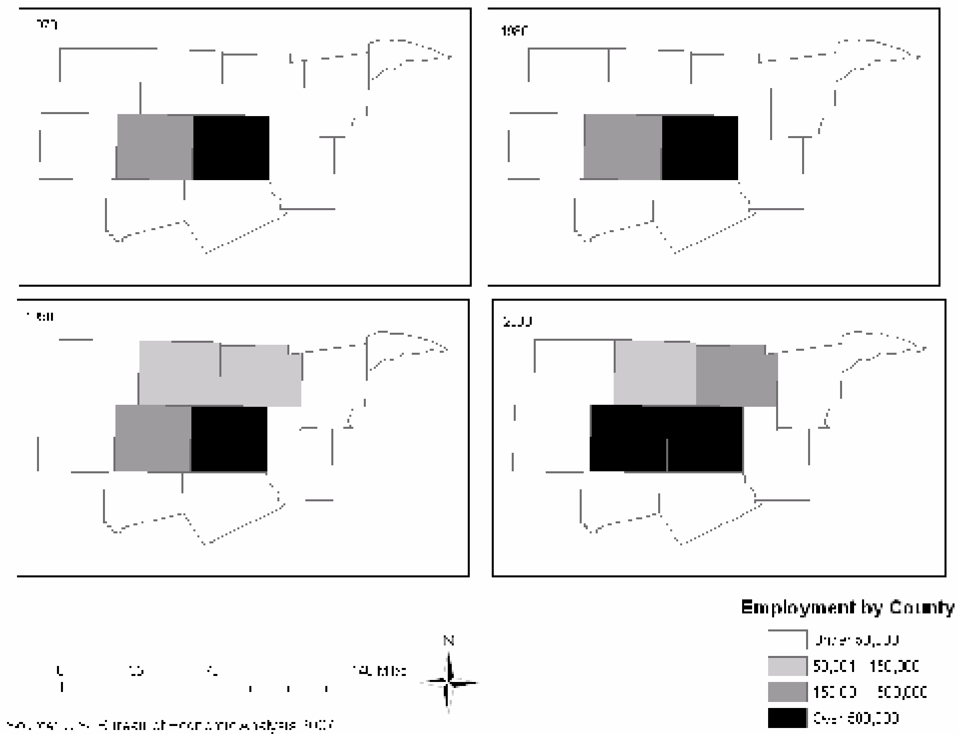


Figure 46 Dallas-Fort Worth MSA: employment by county (1970–2000)

Figure 47 maps employment density in the eleven MSA counties that are included in the North Central Texas Council of Governments (NCTCOG), the local MPO. Employment is displayed as jobs per acre by census tract in 2005. The figure shows that there are major employment concentrations in Dallas, the suburbs north of Dallas, Fort Worth, and the area around Arlington midway between Dallas and Fort Worth. Interestingly, most employment tends to be located north of the central business districts of the two largest cities.

Areas to the south of the Dallas CBD have much less employment than their northern counterparts. The authors' discussions with local contacts in the Dallas area indicate that the communities south of the Dallas CBD tend to be lower income, minority communities. According to the authors' contacts, providing residents of these communities with the ability to reach jobs located in the Dallas CBD and to the north of the Dallas CBD was an important objective of LRT planning in the Dallas area.

Table 35 Employment in the Dallas-Ft. Worth metropolitan area (1970–2005)

Year	Dallas County			MSA Core Counties (2 counties)	Other MSA Counties (10 counties)	Total MSA (12 counties)
	Dallas CBD	Outside Dallas CBD	Total			
1970	65,773	522,520	588,293	820,425	50,064	870,489
1971	68,726	506,410	575,136	792,247	51,411	843,658
1972	71,812	524,605	596,417	811,304	55,368	866,672
1973	75,036	568,089	643,125	874,053	60,197	934,250
1974	78,406	575,715	654,120	896,887	71,805	968,692
1975	81,926	547,270	629,196	868,078	68,366	936,444
1976	85,604	575,942	661,546	915,987	76,720	992,706
1977	89,448	628,610	718,058	994,890	80,345	1,075,235
1978	93,464	687,518	780,982	1,086,728	89,753	1,176,481
1979	97,661	735,607	833,268	1,177,468	100,006	1,277,474
1980	102,000	779,520	881,520	1,238,230	109,835	1,348,065
1981	101,000	831,093	932,094	1,302,480	119,951	1,422,431
1982	100,011	871,111	971,122	1,374,648	136,048	1,510,696
1983	99,030	888,718	987,748	1,395,827	147,221	1,543,048
1984	98,060	977,258	1,075,318	1,518,264	170,906	1,689,170
1985	97,099	1,040,725	1,137,824	1,606,378	193,423	1,799,801
1986	96,147	1,080,306	1,176,453	1,641,766	204,373	1,846,139
1987	95,205	1,050,859	1,146,064	1,604,652	218,297	1,822,949
1988	94,272	1,044,550	1,138,822	1,608,092	224,128	1,832,220
1989	93,348	1,066,554	1,159,902	1,634,186	227,946	1,862,132
1990	92,467	1,101,836	1,194,303	1,687,298	241,911	1,929,209
1991	92,920	1,139,892	1,232,812	1,729,904	242,840	1,972,744
1992	93,375	1,146,599	1,239,974	1,753,736	258,312	2,012,048
1993	93,833	1,152,444	1,246,277	1,777,121	274,604	2,051,725
1994	94,293	1,176,109	1,270,402	1,817,144	295,701	2,112,844
1995	94,755	1,250,325	1,345,080	1,915,655	318,315	2,233,970
1996	95,219	1,281,889	1,377,108	1,979,639	356,598	2,336,238
1997	95,686	1,365,163	1,460,849	2,079,333	380,976	2,460,309
1998	96,154	1,410,223	1,506,377	2,160,697	409,997	2,570,694
1999	96,626	1,443,386	1,540,011	2,218,398	440,542	2,658,940
2000	97,115	1,482,096	1,579,211	2,286,011	471,902	2,757,913
2001	97,591	1,540,467	1,638,058	2,392,101	483,199	2,875,300
2002	98,069	1,471,845	1,569,914	2,316,629	494,998	2,811,627
2003	98,550	1,420,209	1,518,759	2,257,147	514,133	2,771,280
2004	99,032	1,414,794	1,513,826	2,261,211	543,434	2,804,645
2005	99,518	1,412,420	1,511,938	2,278,531	597,714	2,876,245

Source: U.S. Bureau of Economic Analysis, 2007; U.S. Census Bureau 1970,1980, 1990, 2000.

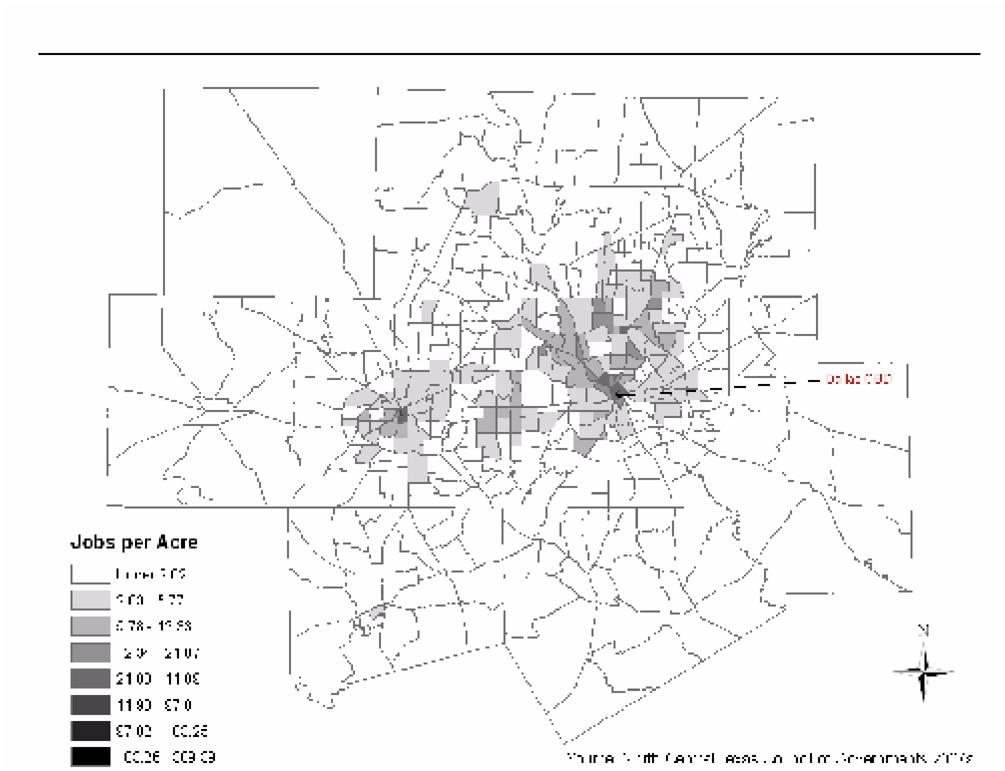


Figure 47 Dallas-Forth Worth MSA: employment density by census tract (2005)

The overall pattern of employment, which tends to be collocated with other major travel destinations, has implications for the structuring of transit service. The dispersed, but clustered, pattern of employment seems to require a multidestination transit route structure to be effectively served by public transit. Such a system would need to include a set of high-speed, frequent-service regional routes to provide connections between the major activity centers in the region. Most of the major employment clusters in the Dallas-Fort Worth metropolitan area are served by public transit, principally DART. A notable exception is the cluster of employment in the Arlington area, midway between Dallas and Fort Worth, which is not served by public transit. The authors discuss this issue in more detail later in the case study.

Institutions and Key Actors

Several public agencies play important roles in the transit planning and policymaking process in the Dallas-Forth Worth Area. Dallas Area Rapid Transit (DART), the Fort Worth Transportation Authority (The T), and the Denton County Transportation Authority (DCTA) plan and operate local transit systems in the metropolitan area. The North Central Texas Council of Governments (NCTCOG), the local MPO, is involved in shaping regional transit policy in the metropolitan area. Local government and county public officials have also played important roles in transit planning and policymaking at different points in the region's transit history. Business organizations, including chambers of commerce, tend to act through the local governments to express their views about regional transit issues.

Dallas Area Rapid Transit

Dallas Area Rapid Transit (DART) operates local and express bus and light rail transit service, primarily in Dallas County. DART is also a partner, with the Fort Worth Transportation Authority, in the operation of the Trinity Railway Express (TRE) commuter rail line between Dallas and Fort Worth. DART is the primary transit agency in the region, in terms of riders carried and service provided.

DART has 12 member cities that contribute sales tax money to its budget. Every six years, any member city can vote to opt out of DART. Two cities have done so. No cities have joined DART since its creation in 1983. DART has a 15-member board whose members are appointed to represent the various member cities; the city of Dallas has eight members on the board.

Denton County Transportation Authority

Denton County Transportation Authority (DCTA) operates local bus service in Denton County and express bus service between Denton County and Dallas. The 14 member board is appointed by individual cities and by county government.

Fort Worth Transportation Authority

Fort Worth Transportation Authority (The T) operates local bus and express service in the Fort Worth area. The T is also a partner with DART in the operation of the TRE commuter rail line. The T is governed by a nine-member board whose members are appointed to represent its member cities.

North Central Texas Council of Governments

North Central Texas Council of Governments (NCTCOG) serves as the metropolitan planning organization (MPO) for the region. NCTCOG membership includes 16 counties and numerous cities, school boards, and special districts; thus, its geographic reach extends beyond the 12-county MSA. Each member government appoints a representative to the NCTCOG general assembly. The assembly elects NCTCOG's 13-member executive board. As the MPO, NCTCOG is responsible for conducting the transportation planning process required as a prerequisite to obtaining federal highway and transit aid.

Transit Agencies, Modes, Fares, and Rider Profiles

Three public transit agencies provide fixed-route transit service in the Dallas-Fort Worth MSA: Denton County Transportation Authority (DCTA), Fort Worth Transportation Authority (The T), and Dallas Area Rapid Transit (DART). The T and DART jointly operate the Trinity Railway Express (TRE), which provides commuter rail service between Dallas and

Fort Worth. Fixed-route transit services are largely confined to four counties: Collin, Dallas, Denton, and Tarrant (see Figure 48).

Small Transit Agency Services, Fares, and Ridership

Combined, DCTA, The T, and TRE carried 51 million passenger miles in 2004 (see Table 36). This represents less than 12% of the Dallas-Fort Worth MSA's total transit ridership. Because these agencies carry a small proportion of MSA transit ridership, this report will briefly discuss their services, fares, and ridership in this section, but will focus on DART in the remainder of the study.

Created in 2002, DCTA is a successor agency to the City of Denton Public Transportation Department's transit service. DCTA operates 10 local bus routes in Denton County and two express bus routes that provide service to the Dallas CBD. Most local DCTA bus routes operate on 60-minute all day headways. The two express bus routes provide peak-period-only, peak-direction service.

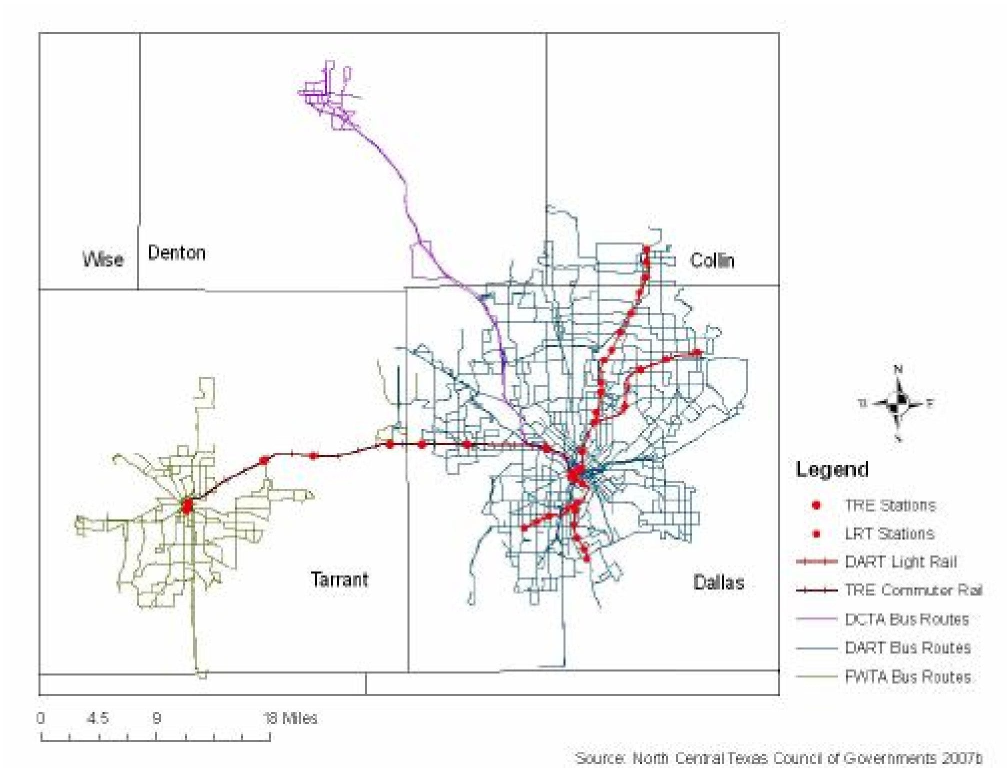


Figure 48 Transit systems in the Dallas-Fort Worth metropolitan area (2007)

DCTA's one-way fare for local service is $1.25; its one-way fare for express bus service to Dallas is $5.00.[124] DCTA provides discounted fares for children, senior citizens, the disabled, and individuals who purchase multi-ride tickets or monthly passes. DCTA has no transfer arrangements with the other operators; DCTA riders must pay full fare when they transfer to or from DART bus or rail. Since the creation of DCTA, transit service has nearly doubled, resulting in the ridership increases shown in Table 36.

The Fort Worth Transportation Authority (The T) operates local and express bus fixed-route services that are largely confined to Tarrant County. The T's transit system follows a radial pattern. The T's route system is focused on the Intermodal Transit Center (ITC) in downtown Fort Worth; more than half the routes serve the ITC. ITC is also the location of a Trinity Railway Express (TRE) commuter rail station. The T's one-way fare is $1.50.[125] The T provides discounted fares for children, senior citizens, the disabled, and individuals who purchase transit passes. Transfers are free to or from any FWTA service and/or to TRE commuter rail service west of the Dallas-Fort Worth airport. Ridership has declined, particularly in the past several years. Ridership in 2004 was less than half its 1990 level.

The Trinity Railway Express (TRE) began service in Dallas in December 1996; the line extended to Fort Worth in December 2001. TRE is jointly operated by DART and the T. The commuter rail service has ten stations. TRE has a zone-based fare system that uses two zones. Single-zone, one-way trip fares are $1.50 and two-zone, one-way fares are $2.50.[126] TRE provides discounted fares to persons under 19, senior citizens, the disabled, and individuals who purchase day or monthly passes. TRE passengers can transfer to local T buses or to DART light rail without paying a fare, provided they transfer within 90 minutes of the time of their ticket purchase.

Most TRE patrons use the service to access the Dallas CBD, where many transfer to LRT to complete their trip, but the hospital district around Parkland Hospital (2 to 3 miles from the Dallas CBD) is also a major travel destination for TRE patrons. Most TRE users access the system using park and ride lots; both of this section's interviewees said that parking capacity has limited ridership on the system to its average of 9,000 riders per day.[127] On event days, TRE may attract up to an additional 1,000 riders. There is little feeder bus service to TRE, although it is fed by a relatively slow shuttle bus that runs from the Dallas-Fort Worth International Airport. TRE ridership increased significantly when the line was completed to Fort Worth, but has declined slightly since that time (see Table 36).

Dallas Area Rapid Transit (DART) Services and Fares

The primary transit operator in the Dallas-Fort Worth MSA is DART. Created in 1983, DART took over operation of the Dallas Transit System in 1984 and officially purchased the bus system from the city of Dallas in 1988. DART began LRT operation in 1996. DART provides transit services to member cities in Collin, Dallas, and Rockwall counties. The majority of the jurisdictions lie in Dallas County.

DART's bus network resembles a modified grid connected to a radial rail transit spine (see Figure 49). DART operates five classes of fixed-route bus service: local bus, express bus, crosstown bus, suburban bus, and rail station-serving bus. Local buses serve the Dallas CBD. Express buses serve both CBD and non-CBD locations. About one-third of all DART bus routes provide service to the Dallas CBD. Suburban and crosstown buses serve non-CBD locations. Rail station-serving buses provide connections to DART LRT stations. Most DART bus routes provide a connection to one or more LRT or commuter rail (TRE) stations. DART presently operates two LRT lines, but has plans for several LRT extensions. DART's rail system dates to the mid-1990s (see Table 37).

Table 36 Transit ridership (passenger miles) on non-DART systems (1984–2004)

Year	Denton County Transportation Authority	Fort Worth Transportation Authority	Trinity Railway Express
1984		25,996,998	
1985		23,787,695	
1986		27,286,469	
1987		26,077,602	
1988		21,543,916	
1989		31,693,345	
1990		48,894,085	
1991		41,969,177	
1992		27,569,034	
1993	305,535	32,344,667	
1994	308,688	34,797,556	
1995	666,448	30,474,382	
1996	818,620	30,275,663	
1997	664,657	28,706,617	1,542,160
1998	744,461	24,962,373	4,455,936
1999	941,787	25,373,686	5,679,210
2000	941,701	27,266,081	6,423,050
2001	599,927	30,617,583	32,269,283
2002	495,184	27,632,150	29,593,702
2003	661,936	24,048,649	30,331,725
2004	947,992	21,537,919	28,361,914

Source: Florida Department of Transportation, 2006.

Note: Fort Worth Transportation Authority excludes commuter rail ridership. All FWTA and DART commuter rail ridership are reported under Trinity Railway Express

DART offers several innovative bus services, including a suburb-to-suburb express route, site-specific shuttle buses, and on-call transit service. DART has one suburb-to-suburb express route (234) that runs from an LRT station in Richardson to a transit center in North Irving, with no intermediate stop. According to the interviews, this route makes four trips a day but carries only 100 passengers per day.[128] One of the interviewees said that the low ridership might be partly attributable to long travel times. The same interviewee noted that there is a high-occupancy vehicle facility in this corridor that might allow faster service to be provided, but that the facility is not designed to permit easy use by buses. DART planners are currently investigating a reconfiguration of the route, although this may prove difficult. The passengers who use the route are upper middle income individuals who are politically well organized, and might try to block a route reconfiguration. DART has tried to deploy suburb-to-suburb express routes in other corridors with similar ridership results.

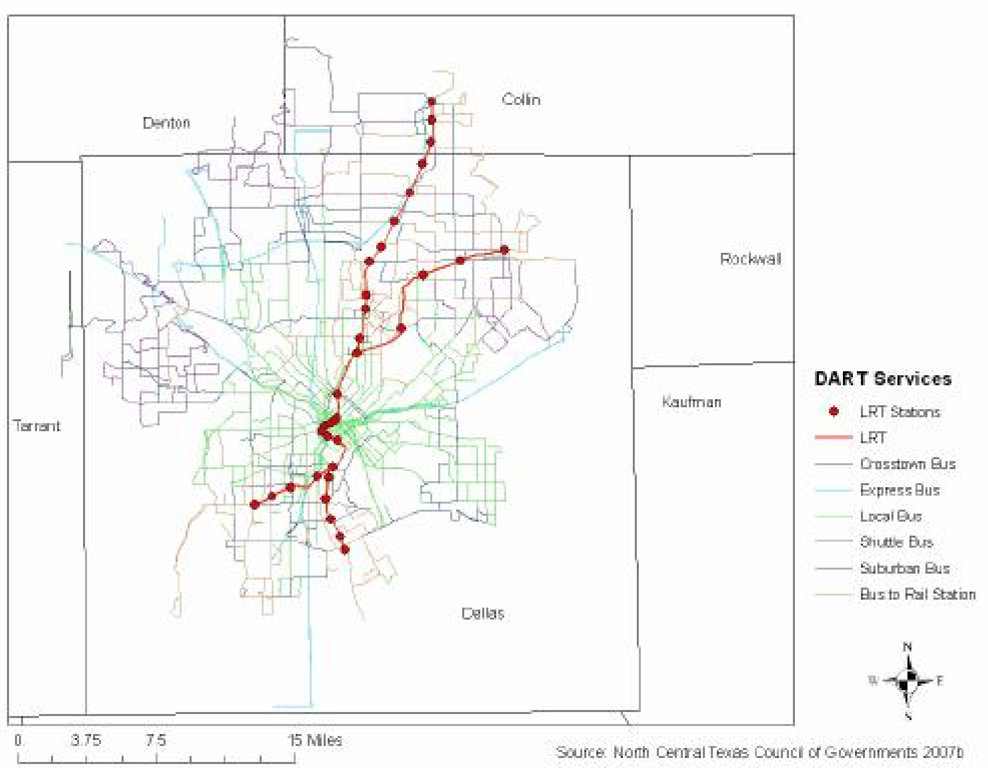


Figure 49 DART transit system (2007)

Table 37 Dallas DART rail segment openings since 1996

Year	Segment Length (miles)	Line	Section	Cumulative System Length (miles)
1996	8.5	Red Line	Westmoreland–West End;	8.5
1996	1.8	Blue Line	Illinois–8th & Corinth	10.3
1997	2.5	Blue Line	Ledbetter–Illinois	12.8
1997	7.2	Red Line	West End–Park Lane	20
2001	3.4	Blue Line	Mockingbird–White Rock	23.4
2002	3.5	Blue Line	White Rock–LBJ/Skillman	26.9
2002	9.3	Red Line	Park Lane–Galatyn Park	36.2
2002	4.1	Blue Line	LBJ/Skillman–Downtown Garland	40.3
2002	3.2	Red Line	Galatyn Park–Parker Road	43.5

Source: Demery, Leroy, *U.S. Urban Rail Transit Lines Opened from 1980*, October 18, 2005, 12.

A recent addition to DART's array of services is the site-specific shuttle service.[129] These are small-scale distribution systems that operate within a 3 to 4 mile radius of some LRT stations.

Ten different entities participate in this service program and share the cost of shuttle bus service with DART. The first of these partnerships was with the upscale North Park Center shopping mall, located 1.5 miles from a DART station. Both of the interviewees said this service is used by mall visitors and employees. The same interviewee emphasized that this type of service partnership cut DART's cost in half, because half the costs are paid by the shopping mall owner.

DART has also implemented an on-call service in affluent areas that lack the densities needed to support fixed-route bus service. DART assigns a bus to a 3-4 square mile area around a rail station, and patrons call to use the service. Both of the interviewees said that the on-call buses are better used than the fixed-route bus service they replaced.[130]

DART's fare structure distinguishes between local and premium service fares.[131] Local fares permit riders to travel on non-express buses and both DART LRT and TRE commuter rail services in the eastern (Dallas) part of the metropolitan area. Single-ride local fares permit riders to use 90 minutes of train travel or a single bus trip; transfers are not included. Single-ride premium fares allow riders to use 90 minutes of train travel or take a single bus trip on any DART, TRE, or The T rail or bus service in the metropolitan area; transfers are not included. As of October 1, 2008, the single-ride local fare for adults is $1.50 and the single-ride premium fare for adults is $2.50. DART sells day passes and monthly passes (both local and premium) that allow riders to transfer without paying additional fares. DART offers discounted fares and pass arrangements for senior citizens, the disabled, and school-age children.

Dallas Area Rapid Transit (DART) Rider Profile

DART commissioned an on-board survey in early 2007 that allows us to develop a profile of DART bus and rail users.[132] DART's survey classifies riders into three groups: bus-only riders (47.6% of all riders), rail-only riders (20.5% of all riders), and multimodal (bus and rail) riders (31.9% of all riders). Table 38 shows that the majority of DART patrons are female; among rail-only patrons, males make up a majority of riders. DART bus patrons tend to have lower household incomes and levels of automobile ownership than do DART rail riders. About 80% of DART bus riders report household incomes under $35,000, and 40% of DART bus rider households have no automobile. By contrast, more than half of rail riders have household incomes above $50,000, and less than one out of every six rail riders are members of households that do not own an automobile. Multi-modal passenger characteristics tend to track those of bus-only patrons more closely than rail-only patrons. According to DART staff, they see more Saturday and off-peak use on LRT than on their buses. This contact cited people's affinity for rail and the "easier" trip on rail as possible explanations for the difference between the modes.

Table 38 Demographics of DART transit riders

Survey Category	Response	Total	Type of Rider		
			Bus Only Percent	Rail Only Percent	Multimodal Percent
Gender	Male	48	46	52	47
	Female	52	54	48	53
Household Vehicles	None	40	50	15	43
	One	30	31	33	28
	Two	21	13	34	22
	Three or more	9	6	18	7
Income	Under $15,000	37	46	13	39
	$15,000 to $34,999	30	34	19	32
	$35,000 to $49,999	12	10	15	12
	$50,000 to $74,999	10	6	22	10
	$75,000 or more	11	4	31	7

Source: NuStats Partners, *DART Transit System Travel Pattern Analysis Study*, Dallas Area Rapid Transit, October 2007, 15–15, 23–25.

ANALYSIS

Regional Transit Vision

The interviewees characterized the Dallas-Fort Worth metropolitan area as one where the regional transit vision is beginning to be articulated more broadly at a larger geographic level than in the past.[133] One of the interviewees noted that prior to the creation of DART, the transit vision was largely the purview of individual transit operators and transit had yet to emerge as an important issue in local or regional transportation policy. This same interviewee placed the unsuccessful attempt to create a regional transit authority in 1980 in the context of an environment in which regional thinking about transit was relatively absent from planning and policymaking. Gradually, community leaders, including members of the Dallas business community, began to recognize the need for regional transit, and began to articulate this need.

A sub-regional vision began to emerge through the series of plans that led to construction of the light rail transit lines in Dallas. This vision, first articulated in Dallas but recently articulated throughout the metropolitan area, encompasses a large rail system to connect suburbs and cities, with buses serving a passenger distribution function. The current vision is thus multimodal. Rail system plans originally called for a heavy-rail system, like BART, that would largely be limited to the city of Dallas.

One of the interviewees said that planning shifted to light rail transit because of San Diego's success in building their low-cost, extensive light rail transit (LRT) system. The lower-cost, light rail-focused vision gained much more support than the earlier heavy rail-focused vision. The rail system proposed under this vision is gradually being realized, and presently includes

43 miles of light rail transit already opened, 35 miles of commuter rail already opened, and 25 to 28 miles of light rail transit under construction.

A recent addition to this rail system vision is Denton County's plan to build commuter rail that will feed into DART's rail system. One of the interviewees said that the metropolitan area's steady progress in opening the proposed segments of rail system has won over many people in the community who were skeptical that the ambitious rail construction program could ever be realized.

The interviewees characterized DART and the NCTCOG as the leading entities in articulating a regional vision. They have recently propounded the notion that transit can play a role in promoting more sustainable urban development patterns. Local cities frequently articulate economic development arguments in their discussion of a transit vision. Cities like Plano, Irving, and Carrollton use the presence of rail transit to attract and shape development around their rail transit stations. The local business community continues to play a role in developing the regional vision, although one more limited than in the period leading to DART's creation. The interviewees characterized the business community as generally supportive of the regional vision, with concerns about congestion and air quality underpinning much of this support.

A significant barrier to the realization of a truly regional (i.e. metropolitan area-wide) transit system is transit finance. There is presently limited ability to fund transit regionally. Most DART-member municipalities use sales tax revenues to fund their membership in DART. Other local jurisdictions also rely heavily on sales tax revenues to fund transit service. However, Texas imposes a cap of 8.25% on the sales tax that can be levied. DART requires a 1% sales tax to provide service in a community; the DCTA requires a 0.5% sales tax to receive its service. Unfortunately, many communities that do not presently have transit service do not have room under their sales tax caps to join DART or one of the other transit services, even if it wished to do so.

One of the interviewees emphasized that the sales tax cap, and not a lack of enthusiasm for DART, is the reason no cities have joined DART since the organization's creation. The interviewees noted that the local transit agencies lobbied the Texas Legislature during the most recent session to exempt transit sales taxes from the sales tax cap, but they were unsuccessful in their efforts. Both interviewees noted that other Texas cities face similar financial difficulties, so Dallas-Fort Worth transit interests might be able to attract allies if they pursue the exemption in a future legislative session.

Another barrier to the realization of a truly regional transit system is public attitudes, particularly in suburban communities. One of the interviewees noted that in places like Arlington there is a concern that transit attracts poor people and crime and that local residents do not want to import these "problems" into their community. The same interviewee said these beliefs run very deep and are especially strong with regard to bus service. Rail service, which attracts a different socioeconomic class rider, is viewed much more favorably in these communities than bus service.

Regional Transit System Structure and Function

Most transit service in the region is operated by DART, whose service is restricted to the eastern part of the MSA centered in Dallas County. Prior to creation of DART, fixed-route transit service in Dallas County (outside Dallas itself) consisted solely of park-and-ride-based express service between suburbs and the Dallas CBD. Some of these services, most noticeably that in Garland, attracted sizeable shares of the commute market for trips between that origin and the Dallas CBD destination. However, the total numbers of riders carried by these services were small, which is not surprising given the decentralized nature of employment in the Dallas area.

By 1986, shortly after DART's creation, there was fixed-route service in the suburban member communities. To operate this service, DART relied on transfer centers and a timed-transfer service model. Transfer centers became focal points for both local buses and for park-and-ride-based express buses serving the Dallas CBD. Thus, the interviewees emphasized that DART embraced a multidestination service philosophy very early in its history. One interviewee noted that the decentralized nature of the Dallas area required this approach to transit service structure. However, given that nearly half (46%) of DART service is allocated to routes serving the CBD, the authors would still characterize the system as having a strong radial component.

The interviewees emphasized that the multidestination service philosophy is reflected in the development of light rail transit. One interviewee observed that LRT was designed to service both CBD and non-CBD employment. The planning process called for people to transfer between LRT and bus to reach jobs. Bus routes would be structured as a spider web emanating from LRT stations. Buses would function as collectors and distributors of passengers, while rail would serve a trunk line function in heavy corridors. This philosophy carried over from LRT planning to LRT implementation. There are some corridors where bus serves a radial function, but the bus system as a whole has evolved to being a combination of both a feeder and distributor system for rail transit.

As noted earlier, DART has 25 to 28 miles of LRT under construction at present. Both interviewees characterized LRT as the main framework for the transit system; however, escalating costs have prompted greater interest in BRT development in the region. There have been no formal studies for dedicated guideway BRT, but DART does have provisions for enhanced bus service (low-cost BRT in mixed-flow traffic) in its current transit system plan.

Transfers

Table 39 provides information from the DART on-board survey about rider use of the various transit modes and rider transfer activity. The table indicates that just under half of DART patrons are bus-only users, while about one-third of patrons use a combination of light-rail and bus service. More than half of DART patrons choose to make a transfer to make their trip; only 46% of patrons are one-seat riders who do not need to transfer. One interviewee characterized the level of bus-to-bus transferring at rail stations, including those in suburban areas, as quite high.

Table 39 Mode use and transfer activity by DART riders

Type of Transit Mode		Number of Transit Modes	
Response	Total Percent	Response	Total
Bus only riders	48	1-seat rider	46
Rail only riders	20	2-seat rider	35
Multi-modal riders	32	3-seat rider	14
		4+ seat rider	5

Source: NuStats Partners, *DART Transit System Travel Pattern Analysis Study*, Dallas Area Rapid Transit, October 2007, 14, 22.

DART patrons might also wish to transfer to or from one of the other operators in the Dallas-Fort Worth area. One of the interviewees noted that transfers are seamless between DART and the Fort Worth T. Patrons can purchase a one-ticket ride from Dallas to Fort Worth. Presently, there is no coordination between DCTA buses and DART, and hence no passenger transfer activity between the two systems. One of the interviewees noted that construction of the Denton County commuter rail line might change this pattern, because the line is planned to use the DART LRT line to access the Dallas CBD.

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

The Dallas-Fort Worth Metropolitan Area has experienced many peaks and valleys in terms of overall regional ridership and productivity. Riding habit, defined as the ratio of passenger miles to population (passenger miles per capita), is relatively unchanged from 1984 to 2005, but there have been significant changes from year-to-year during the intervening years (see Figure 50). Riding habit increased after DART's creation (and the addition of service to previously unserved areas), fell with a fare increase in the late 1980s, increased again with the restructuring of bus service from a radial pattern to a multidestination pattern and the introduction of rail transit, and fluctuated in reflection of service extensions and overarching economic conditions in the subsequent period.

Productivity, defined as the ratio of passenger miles to vehicle miles (or load factor), has declined by about 25% since 1984, although it has also experienced peaks and valleys (see Figure 51). Much of the decline in productivity occurred in the mid-1980s, as DART extended its service to reach previously unserved parts of its service area. Since 1986, productivity has increased. Notable peaks in productivity are associated with bus service restructuring in the late 1980s and the opening of rail segments in the mid-to-late 1990s.

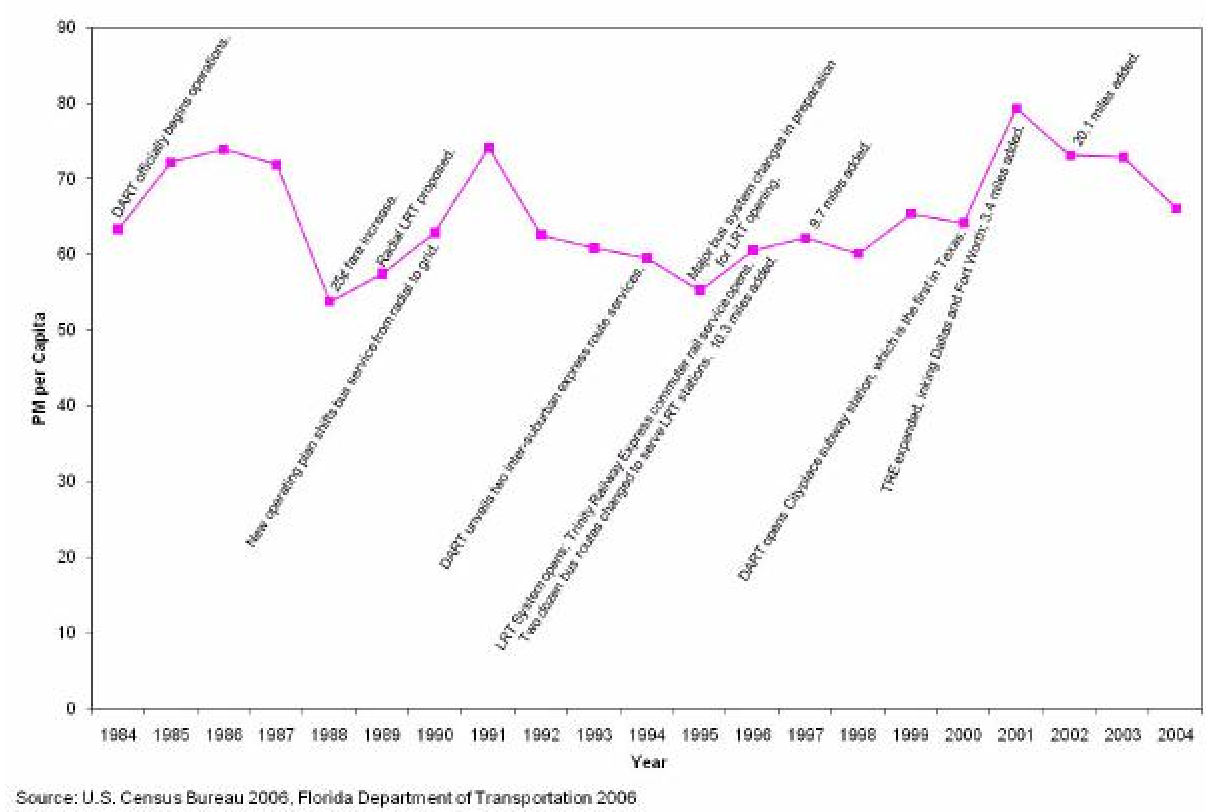


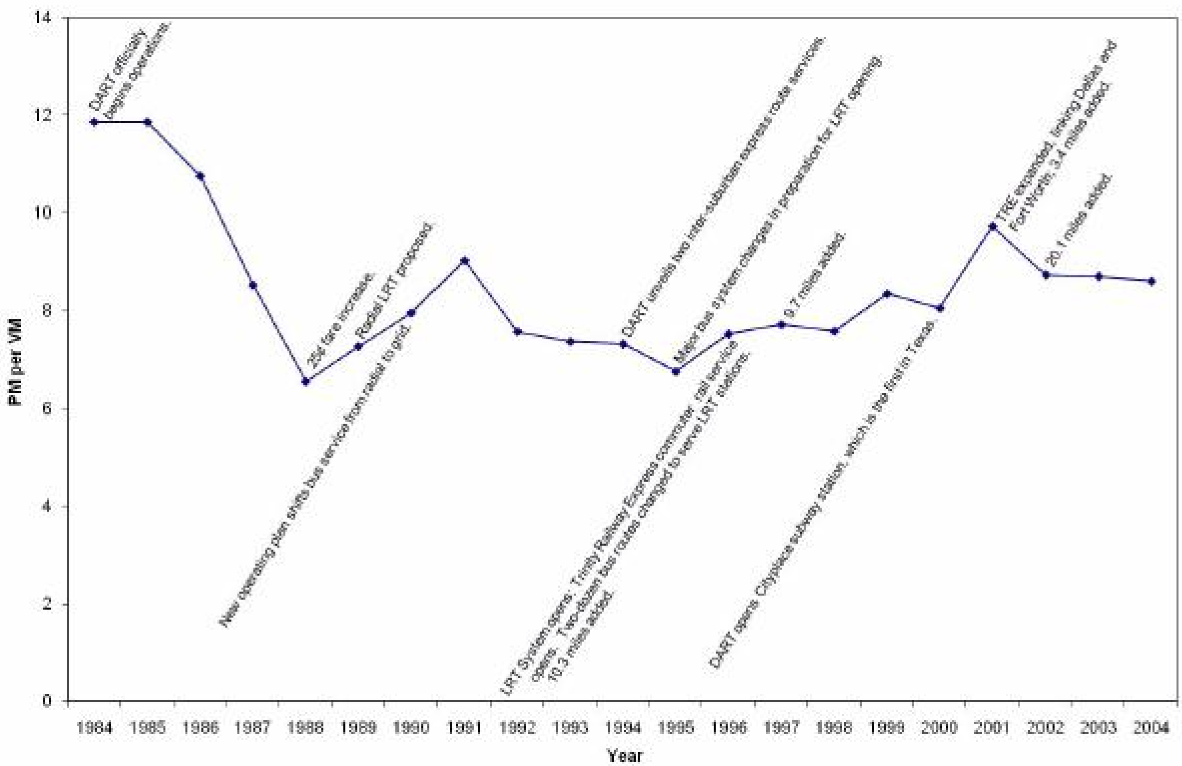
Figure 50 Dallas-Fort Worth MSA riding habit (passenger miles per capita) (1984-2004)

DART System Ridership and Productivity Trends

Table 40 presents DART ridership, on a mode and total basis, from 1984 to 2004, the most recent year for which these data were available at the time of data collection. The table reports ridership on both a passenger miles and unlinked passenger trip (or boarding) basis. The table indicates that between 1984 and 2004, overall transit patronage (measured on either ridership basis) has increased significantly, but that the increase in passenger trips has outpaced the increase in passenger miles. In the case of bus service, passenger miles have actually declined slightly since 1984 even as unlinked passenger trips have increased by more than one-third.

Table 41 shows that average trips lengths have declined for DART bus patrons and trip lengths have lengthened for rail patrons. For the average DART patron, trip lengths have declined slightly, falling in the 1980s and then increasing as rail segments opened, beginning in 1996. The declining length of DART bus trips is likely a function of service restructuring as the system evolved from a radial to a multidestination route structure and as bus routes were truncated to feed rail stations as rail lines opened. The increasing length of DART rail trips is likely a function of the opening of new segments on the DART LRT line. The lengthening of the DART LRT system has enabled people to travel from residential areas in heavily minority southern Dallas County to jobs in more affluent northern Dallas County and southern Collin

County, which both of the interviewees noted was an important travel pattern for DART patrons.



Source:Florida Department of Transportation 2006

Figure 51 Dallas-Forth Worth MSA load factor (passenger miles per vehicle mile) (1984-2004)

Table 40 Ridership on DART fixed route transit services

Year	Passenger Miles			Unlinked Passenger Trips		
	DART Bus	DART Rail	DART Total	DART Bus	DART Rail	DART Total
1984	229,451,129		229,451,129	42,490,950		42,490,950
1985	247,820,790		247,820,790	45,892,739		45,892,739
1986	261,116,869		261,116,869	48,354,968		48,354,968
1987	222,032,335		222,032,335	41,117,099		41,117,099
1988	152,650,691		152,650,691	48,479,636		48,479,636
1989	168,433,815		168,433,815	41,760,109		41,760,109
1990	169,765,391		169,765,391	44,423,722		44,423,722
1991	211,496,469		211,496,469	49,205,133		49,205,133
1992	187,085,542		187,085,542	49,758,206		49,758,206
1993	170,065,736		170,065,736	48,250,070		48,250,070
1994	162,763,021		162,763,021	44,911,551		44,911,551
1995	173,271,073		173,271,073	43,880,562		43,880,562
1996	179,753,254	2,990,764	182,744,018	46,672,326	1,481,603	48,153,929
1997	156,306,605	43,192,935	199,499,540	41,681,995	7,971,680	49,653,675

Table 40 Ridership on DART fixed route transit services

Year	Passenger Miles			Unlinked Passenger Trips		
	DART Bus	DART Rail	DART Total	DART Bus	DART Rail	DART Total
1998	151,650,572	58,916,771	210,567,343	40,776,495	10,949,625	51,726,120
1999	179,360,815	60,468,675	239,829,490	45,936,185	11,345,880	57,282,065
2000	179,360,815	60,197,211	239,558,026	45,936,185	11,433,508	57,369,693
2001	232,804,897	61,071,759	293,876,656	48,851,745	11,571,066	60,422,811
2002	190,579,342	74,433,218	265,012,560	44,807,828	13,733,066	58,540,894
2003	248,023,640	120,674,127	368,697,767	57,614,256	16,996,356	74,610,612
2004	218,457,091	122,621,739	341,078,830	58,901,932	16,375,995	75,277,927

Source: Florida Department of Transportation, 2006.

Table 41 Average trip lengths (DART) (1984–2004)

Year	Average Trip Length (miles)		
	DART Bus	DART Rail	DART Total
1984	5.40		5.40
1985	5.40		5.40
1986	5.40		5.40
1987	5.40		5.40
1988	3.15		3.15
1989	4.03		4.03
1990	3.82		3.82
1991	4.30		4.30
1992	3.76		3.76
1993	3.52		3.52
1994	3.62		3.62
1995	3.95		3.95
1996	3.85	2.02	3.79
1997	3.75	5.42	4.02
1998	3.72	5.38	4.07
1999	3.90	5.33	4.19
2000	3.90	5.26	4.18
2001	4.77	5.28	4.86
2002	4.25	5.42	4.53
2003	4.30	7.10	4.94
2004	3.71	7.49	4.53

Source: Florida Department of Transportation, 2006.

DART service has increased since 1984, although the increase has occurred in two distinct phases (see Table 42). The fist substantial increase in service occurred shortly after DART's creation, as service was added to previously unserved areas of DART's member cities. The more recent service increases are associated with the opening of the LRT system in the mid-to-late 1990s and a large spike in bus service in 2003 and 2004.

Service increases have significantly outpaced ridership growth; with the result being a decline in service productivity (see Table 43). Bus service productivity declined significantly between the mid 1980s and mid 1990s, as DART added service to areas that had not traditionally been served by transit. Bus service productivity then stabilized, as the system was restructured to become more efficient, until the most recent major service expansion. Rail productivity has been relatively flat since the first full year of LRT system operation.

Table 42 DART fixed route transit service (1984–2004)

Year	Vehicle Miles		
	DART Bus	DART Rail	DART Total
1984	15,785,054		15,785,054
1985	19,047,582		19,047,582
1986	22,638,798		22,638,798
1987	21,115,252		21,115,252
1988	20,988,037		20,988,037
1989	19,981,872		19,981,872
1990	20,370,486		20,370,486
1991	21,785,124		21,785,124
1992	22,343,059		22,343,059
1993	22,310,083		22,310,083
1994	22,188,051		22,188,051
1995	22,930,293		22,930,293
1996	22,243,075	403,662	22,646,737
1997	21,544,852	1,820,025	23,364,877
1998	21,351,452	2,638,830	23,990,282
1999	21,610,013	2,457,835	24,067,848
2000	22,291,782	2,451,300	24,743,082
2001	23,160,655	2,596,426	25,757,081
2002	23,762,679	4,005,475	27,768,154
2003	36,523,353	5,683,503	42,206,856
2004	34,188,330	5,212,845	39,401,175

Source: Florida Department of Transportation, 2006.

Table 43 DART service productivity (1984–2004)

Year	DART Bus	DART Rail	DART Total
1984	14.54		14.54
1985	13.01		13.01
1986	11.53		11.53
1987	10.52		10.52
1988	7.27		8.43
1989	8.43		8.43
1990	8.33		8.33
1991	9.71		9.71

Table 43 DART service productivity (1984–2004)

Year	DART Bus	DART Rail	DART Total
1992	8.37		8.37
1993	7.62		7.62
1994	7.34		7.34
1995	7.56		7.56
1996	8.08	7.41	8.07
1997	7.25	23.73	8.54
1998	7.10	22.33	8.78
1999	8.30	24.60	9.96
2000	8.05	24.56	9.68
2001	10.05	23.52	11.41
2002	8.02	18.58	9.54
2003	6.79	21.23	8.74
2004	6.39	23.52	8.66

Bus Route Performance Analysis

In an attempt to better understand which kinds of services and markets are growing and which ones are declining, the authors obtained individual route ridership and service statistics for all DART bus routes.[134] Available ridership data included average weekday, Saturday, and Sunday unlinked passenger trips; neither passenger mile nor linked passenger trip data were available on a route-by-route basis. Available service data included average weekday, Saturday, and Sunday revenue miles, revenue hours, vehicle miles, and vehicle hours. These data refer to fiscal year 2007.

As measures of route-level transit performance, the authors decided to use both unlinked passenger trips per revenue hour and unlinked passenger trips per revenue mile (see Table 44). The values for the former statistics for the average weekday ranged from a low of 3.02 to a high of 47.28. The median value for weekdays was 20.22 unlinked passenger trips per revenue hour. The values for the latter statistic for the average weekday ranged from a low of 0.31 to a high of 7.56. The median value for weekdays was 1.35 unlinked passenger trips per revenue mile.

The authors decided that an important focus of the route-based analysis should be to distinguish between routes that served the Dallas CBD and those that do not. About 46% of all weekday revenue miles are allocated to DART bus routes that serve the Dallas CBD; the remaining 54% of revenue miles is allocated to non-CBD-serving routes.[135] As noted earlier, DART distinguishes five types of bus routes: local, express, suburban, crosstown, and routes that connect to rail stations. The authors report performance statistics for each type of bus route classified into CBD-serving and non-CBD-serving routes.

Table 44 reports the performance of the various types of routes. The table shows that the median CBD-serving route outperforms the median non-CBD route on both ridership measures for all days of service. However, the highest performing single class of routes (for weekdays, using trips per revenue mile) is the set of crosstown routes, none of which serve the Dallas CBD. The local routes, which serve the CBD, are the next highest performers, followed by the routes that serve the rail stations. Using trips per revenue hour as the gauge of weekday route performance, express routes serving the CBD are the strongest performers followed by crosstown routes that do not serve the CBD. The crosstown routes outperform the other routes on Saturdays (on both measures) and rank either first or second (depending on the measure selected) for Sundays.

Table 44 DART bus route performance

Route Type	Routes	Trips per Revenue Hour (median)			Trips per Revenue Mile (median)		
		Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
All routes	128	20.22	15.73	11.73	1.35	1.08	0.93
CBD-serving routes (all routes)	45	24.08	18.05	12.25	1.53	1.44	1.07
Non-CBD routes (all routes)	83	18.07	14.31	11.07	1.26	1.04	0.85
Local routes (serving CBD)	35	23.92	18.05	12.25	1.70	1.44	1.07
Express routes (serving CBD)	10	24.17			0.79		
Express routes (not serving CBD)	1	14.96			0.62		
Suburban routes (not serving CBD)	31	15.29	11.75	8.36	1.12	0.81	0.51
Crosstown routes (not serving CBD)	19	24.03	19.97	13.86	1.74	1.50	1.03
Routes to rail stations (not serving CBD)	32	17.53	13.98	8.01	1.26	1.04	0.77

Sources: Dallas Area Rapid Transit, 2007b, 2007c.

Rail Station Entries

DART provided counts of passengers boarding Red and Blue Line LRT stations for a typical weekday in 2006, broken down by time of day. By looking at only those passengers boarding during the afternoon peak period, which the authors defined as occurring between 3:00 and 6:00 p.m., they were able to judge the extent of usage of the two light rail lines by traditional and non-traditional riders (see Table 45). Traditional riders are those who board trains in the CBD during the afternoon peaks and make trips from the CBD to suburban residences. Non-traditional riders are passengers boarding at non-CBD stations during the afternoon peak period. This examination shows that 43% of Red Line passengers boarded at non-CBD stations during the afternoon peak period, while 47% of Blue Line passengers boarded at non-CBD stations during the afternoon peak. Figure 52 shows the configuration of the two light rail lines and identifies the stations of both lines that serve the Dallas CBD.

Table 45 Dallas (DART) LRT afternoon peak period boardings

Type of Boarding	Blue Line		Red Line	
	Number	Percent	Number	Percent
Passengers boarding in CBD	1,990	54.70	3,485	57.02
Passengers boarding on southern leg	1,258	33.32	999	16.34
Passengers boarding on northern leg	528	13.98	1,628	26.64
Total p.m. peak boarding passengers	3,776	100.00	6,112	100.00

Source: Complied from data provided by Gary Hufstedler, Senior Manager, Planning Information and Analysis, DART, November 21, 2007.

Clearly both lines are being used heavily by non-traditional passengers, but their usage patterns differ. The Red Line appears to serve more employment clusters (particularly in the suburbs north of Dallas) than does the Blue Line, and this attribute likely accounts for the larger number of boardings on its northern leg during the afternoon peak compared to the Blue Line (see Figure 47). Both the Red and Blue Lines serve the poorer minority populations in the areas south of the Dallas CBD equally well, and they experience approximately the same number of boardings on their southern legs. The Red Line's greater traditional traffic from the CBD may result from its penetrating a larger catchment area in the north of affluent residential areas.

Emerging and Declining Ridership Markets

The interviewees both reported that while DART buses serve a predominantly low-income market, DART LRT serves a mixed income clientele, and TRE commuter rail serves a high-income clientele, they are beginning to see more mixed-income ridership on all these services.[136] The earlier discussion of rider profiles indicates that multi-modal riders have a similar profile as bus-only riders, while rail-only riders have a different, less transit dependent, profile. One sociodemographic group DART is actively pursuing is the elderly. The interviewees noted that DART believes on-call services are particularly useful for this group of travelers.

The interviewees noted that they are seeing more riders bound for non-CBD destinations, including in suburban areas. Still, they see the CBD as an important travel destination, and will continue to focus a significant portion of their service to serving this travel destination. One interviewee pointed to the recent growth of population in the Dallas CBD as perhaps presaging an increase in employment in the CBD.

Recently, DART has experienced increased rail and express bus ridership, which one of the interviewees attributes to the recent rise in gasoline prices. This contact says that half of the spike in rail and express bus patronage remained after gas prices moderated. Growth is especially strong in long-distance commuter market from the northern tier of suburbs. To the south, DART is largely limited to Dallas. The contact believes there would have been growth in the same kinds of markets here as well if DART served a wider geographic area to the south.

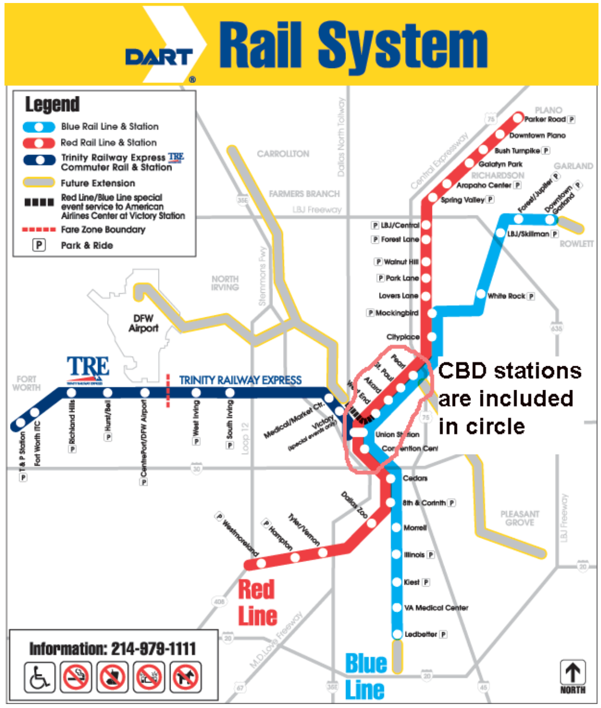


Figure 52 DART's Red and Blue Lines, showing stations serving CBD

Transit and Development

In Dallas, rail transit investment has been viewed as a development tool, both in CBD and non-CBD locations. Many suburban communities are actively promoting development around transit stations, as noted earlier in the case study. One of the interviewees believes that rail development has had a positive effect on the Dallas CBD. This contact points to the reuse of office buildings as mixed-use developments, new restaurant and entertainment development, and significant residential development as evidence of rail's positive effect on the CBD. Given that DART's single LRT alignment through the CBD will be saturated with trains by 2010, this interviewee stresses the need for an additional LRT alignment in downtown Dallas. He believes that once this new alignment is in place even more redevelopment will occur.

Dallas has also seen significant transit-oriented development (TOD) outside the Dallas CBD. The Mockingbird Station TOD is viewed as successful as a ridership generator. This station is a junction station that sees a 50/50 directional ridership split during the a.m. peak period. Some of this activity could be related to transfer movements. The downtown Plano TOD is another development that is seen as contributing ridership to the system. There is also significant redevelopment activity around the Park Lane Station. Here, a large multi-use development that includes 300,000–400,000 square feet of retail is being built oriented to the rail station, with an elevated pedestrian bridge to the station platform. One of the interviewees sees this development as a potential boon to ridership.

Public Attitude Toward Transit

The interviewees both noted that Dallas residents were at one time very apprehensive about DART's ambitions.[137] The rail plan itself passed with only a bare majority (51%) of voters voting in favor. Both interviewees emphasized, however, that the public is generally very supportive of transit.

DISCUSSION

This analysis of Dallas suggests a divergence between transit planning and performance inside the DART service area and elsewhere in the region. Inside the DART service area, transit performance has fluctuated but the trends have been up since the introduction of light rail. At DART's creation, the system expanded service to previously unserved areas and experienced diminishing ridership (per capita) and service productivity. Since that time, planning decisions associated with introduction of light rail transit resulted in DART's transformation from a radial to a partly multidestination system. These changes, in turn, resulted in ridership and productivity gains. Much of this ridership is from the lower end of the socio-economic spectrum, except for rail-only riders who have a higher socio-economic status. The analysis shows that DART riders are using the system to access an array of CBD and non-CBD destinations. The strong performance of its crosstown bus routes and the large numbers of non-traditional riders on the LRT attest to its success in tapping the non-CBD markets, in particular. The introduction of light rail transit also transformed DART's image, and the agency now enjoys local public and political support.

Outside the DART service area, a different picture emerges. Fort Worth's "The T" is a classic CBD-radial system that has experienced dramatic ridership and productivity declines in recent years. DCTA is a growing system, but it is so new that it is hard to get a sense of its overall ridership and performance trajectory. Trinity Railway Express (TRE) is stagnant. From the analysis, it appears that TRE does not serve any meaningful role in regional travel. It connects the Dallas and Fort Worth CBDs but passes by much employment without serving it. It could play a more meaningful role if other transit operators leveraged the line's presence and used it as a trunk connecting to local bus routes in, for example, the Arlington area that is presently not served by transit. Right now, TRE exists on its own, and does not relate well with other services.The authors' sense is that DART is making many good decisions in its service area, but that these good decisions are being overwhelmed by a lack of regional transit planning and an absence of effective regional transit services.

Figure 53 plots the present Dallas area transit system on top of the pattern of regional employment. Bus routes are displayed as thinner lines, and rail lines are displayed as wider lines. From this map it is clear that the DART part of the region has a transit system that serves the major destinations, while the rest of the region lacks important elements in its transit system. Overall, the authors' sense is that the Dallas region lacks three things that the authors see as key for regional transit success. First, transit does not serve the major employment centers in the Arlington area. This absence of service is due to a combination of negative public attitudes and state legislation that caps the sales tax that a city can levy. It is hard to imagine that the region as a whole can have a successful transit system without serving such an important set of travel destinations.

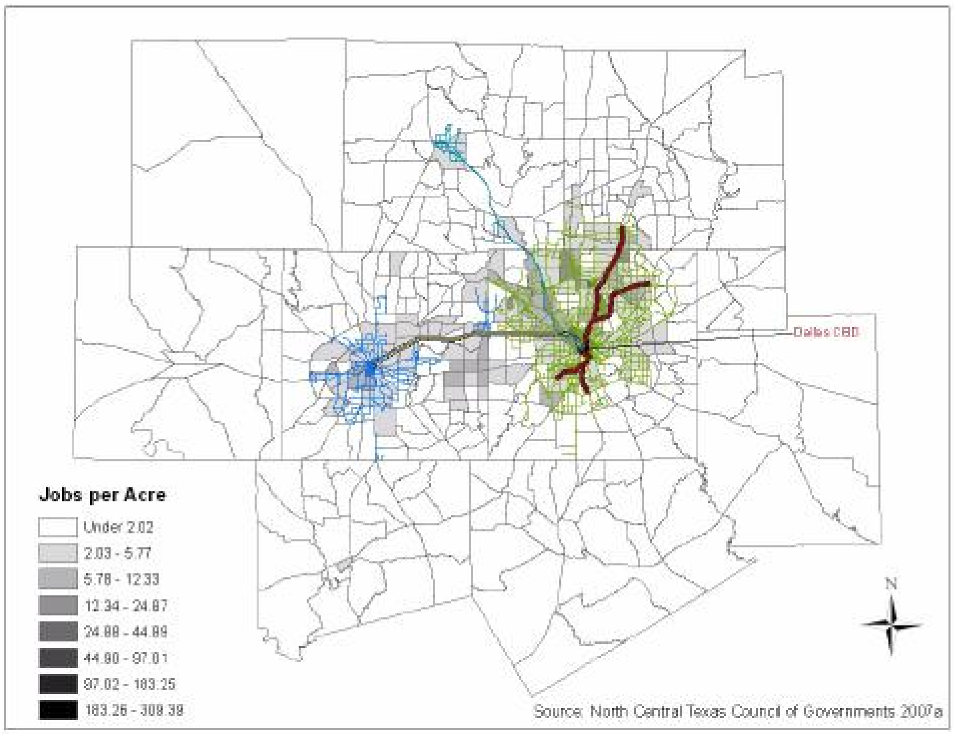


Figure 53 Dallas-Fort Worth MSA transit system and its relation to employment (2005)

Second, the region lacks a multidestination focus outside the DART service area. Other transit operators, most notably The T, focus on a CBD market, and this has led to declining ridership as the region continues to decentralize. Regional transit success requires that operators serve the diverse array of destinations travelers wish to reach and not just one of these destinations (and a declining one at that). The authors' sense is that if the multidestination service strategy embraced by DART was applied, for example, in Fort Worth, regional ridership and service productivity would be much higher.

Third, the region lacks an inter-connected network of high-speed regional transit services that link major activity centers. Such a system could be constructed from a combination of regional rail and bus rapid transit services, and could include TRE as one of its components. It might also include LRT if the service was capable of relatively high speeds. This regional system would be super-imposed over the existing transit networks. A high-speed system is necessary to make transit competitive, given the long trips that would result in this decentralized metropolitan area. Existing express bus services to the Dallas CBD are not useful in this regard. This hypothetical regional system represents the logical extension of successful ideas being used by DART inside its service area to the entire region.

APPENDIX C
DENVER, COLORADO

SETTING

For this study, the authors define the Denver Metropolitan Statistical Area (MSA) to include both the Denver MSA and Boulder MSA, as defined by the Office of Management and Budget (2006). They chose to do so because the two MSAs are integrated economically and are served by a single public transit agency, the Regional Transportation District (RTD).

The Denver MSA, as defined, consists of 11 counties in eastern Colorado with a total land area of just over 9,000 square miles (see Figure 54).[138] With 2.6 million persons in 2005, the Denver MSA ranks as the nation's 22nd largest in population.[139] The MSA's population density is just over 290 persons per square mile.

Seven counties represent the center of population and employment in the Denver MSA: Adams, Arapahoe, Boulder, Broomfield, Denver, Douglas, and Jefferson. In this report, these counties are referred to as the MSA Core Counties. Denver County is the location of the city of Denver, the MSA's largest city, while Boulder County is the location of the city of Boulder, site of the main campus for the University of Colorado. Overlaid on top of the county map is the present service area boundary for the RTD.

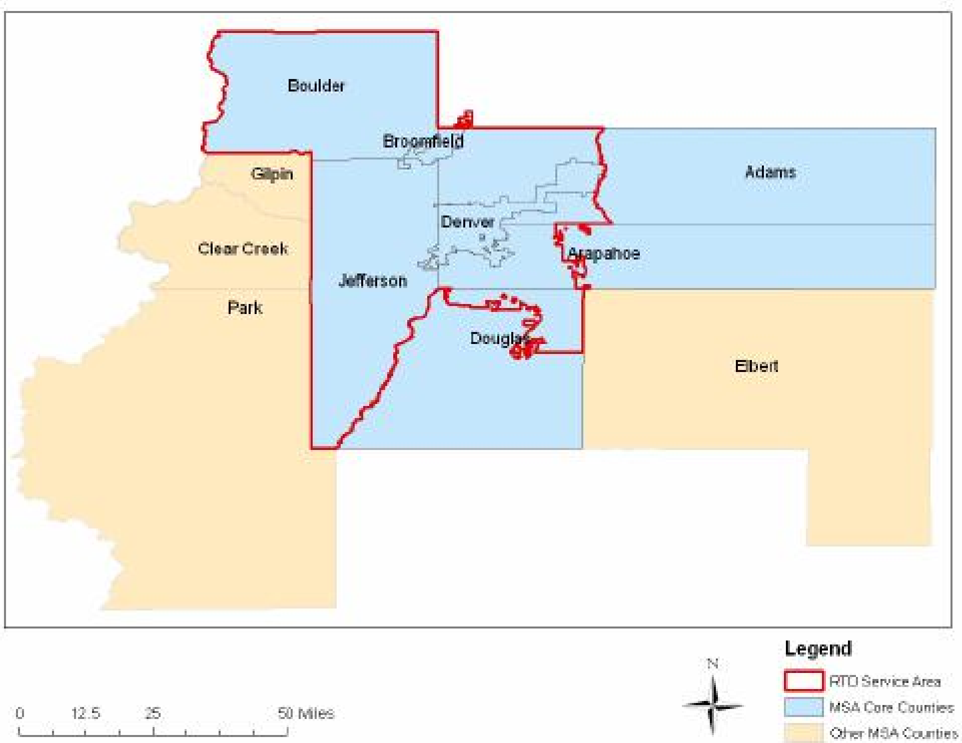


Figure 54 Denver metropolitan statistical area

Distribution of MSA Population

Denver is a rapidly growing, and increasingly decentralized, metropolitan area. Population has decentralized since 1970, as shown in Figure 55. This figure provides maps of population by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of population from Denver County to the other core counties in the MSA.

Between 1970 and 2005, total MSA population increased 111%, from around 1.3 million to just over 2.6 million persons (see Table 46). Population growth in the MSA core counties has been much slower (109%) than in the rest of the MSA (342%); however the non-core counties account for less than 3% of the total MSA population. Denver County's population has fluctuated above and below 500,000 persons since 1970.

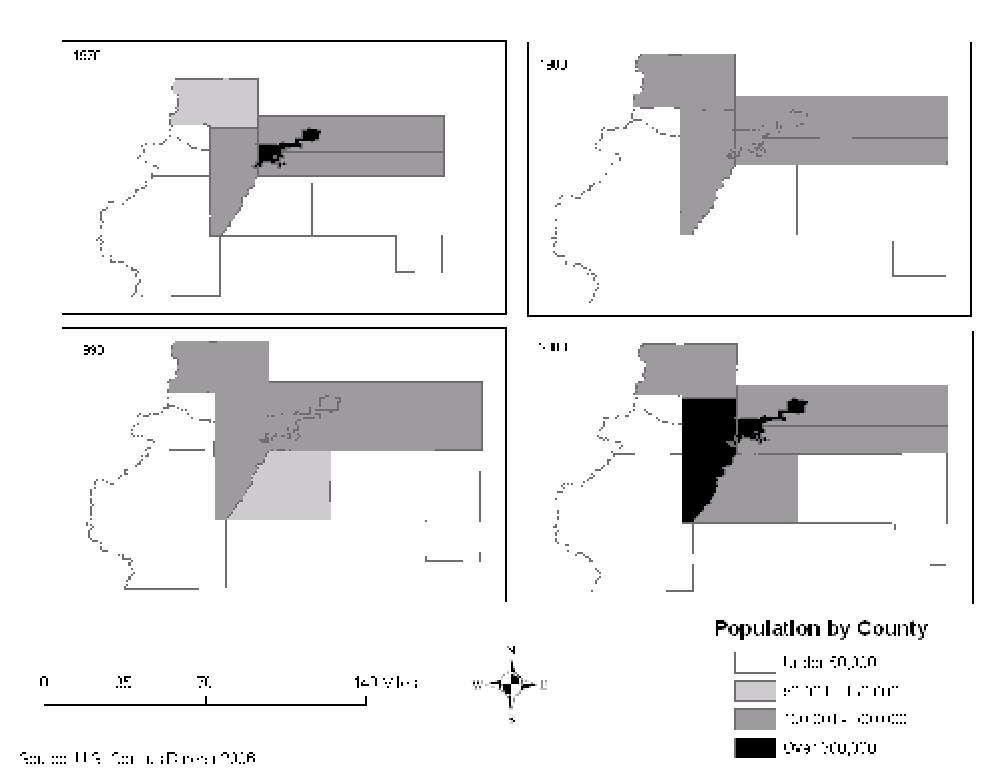


Figure 55 Denver MSA: population by county (1970–2000)

Thus, most population growth and decentralization has occurred within the MSA core counties. Particularly striking is the difference in population growth rates between Denver County and the other core counties. Denver County's population has grown only 8% since 1970, while the other counties have grown 280% over the same period. In 1970, Denver County accounted for 41% of the MSA population, while the other core counties accounted for 57% of the MSA population. By 2005, Denver County accounted for 21% of the MSA population and the other core counties accounted for 76% of the MSA population.

The seven MSA core counties occupy about 4,500 square miles and have an average population density of 574 persons per square mile.[140] The remaining four counties occupy about 4,500 square miles and have an average population density of about 12 persons per square mile.[141] Of these four counties, only Elbert and Park counties have more than 15,000 residents.

Figure 56 shows that MSA population is concentrated in relatively small geographic areas within the MSA core counties, but that it is dispersed within each of these areas. The figure displays population density (persons per acre) by transportation analysis zone (TAZ) in 2005, the most recent year for which these data are available.[142] (County boundaries are shown in red, dark lines) The densest clusters of population are located in Denver and its immediately adjacent clusters, while there are satellite clusters in Boulder and Longmont in the northwestern quadrant of the map.

Distribution of MSA Employment

Employment has also grown and decentralized, but it remains slightly more concentrated than population (see Figure 57). This figure provides maps of employment by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of employment from Denver county first to Jefferson county then to Adams, Arapahoe, and Boulder counties and finally to Douglas county. The maps show very little employment in the remaining counties of the MSA.

Total MSA employment has increased steadily since 1970. Between 1970 and 2005, total MSA employment increased 230%, from 870,000 to 2.9 million jobs (see Table 47). Employment growth in the MSA core counties has been much slower (190%) than employment growth in the rest of the MSA (490%), although the MSA core counties still account for 98% of all MSA employment. The Denver CBD has seen steady employment growth between 1970 and 2005. The CBD's percentage growth rate (243%) far exceeds the percentage growth rate of suburban employment inside Denver County (12%) and of suburban employment throughout the remainder of the MSA core counties (185%). However, the Denver CBD still accounts for less than 10% of regional employment.

Figure 58 maps employment density (by transportation analysis zone) in the core of the Denver MSA in 2005. Employment density is measured as the number of jobs per acre. (county boundaries are shown in red, dark lines.) The map indicates that there are employment concentrations in the Denver CBD and immediately adjacent areas, in the Boulder area, and in corridors that correspond to major highways or arterial roads. The corridor of high density employment that runs southeast from the CBD is particularly striking. One of the interviewees observed that this corridor is second only to the Denver CBD as a major employment center in the state of Colorado. This corridor is served by one of RTD's light rail transit lines.

Table 46 Population in the Denver metropolitan area (1970–2005)

Year	Denver County	MSA Core Counties (7 counties)	Other MSA Counties (4 counties)	Total MSA (11 counties)
1970	514,678	1,238,273	12,179	1,250,452
1971	525,600	1,290,100	13,400	1,303,500
1972	525,800	1,342,700	14,300	1,357,000
1973	525,300	1,392,300	15,100	1,407,400
1974	514,700	1,414,100	15,200	1,429,300
1975	500,600	1,436,200	16,300	1,452,500
1976	501,100	1,468,800	16,700	1,485,500
1977	498,700	1,504,600	17,100	1,521,700
1978	495,200	1,555,400	18,300	1,573,700
1979	495,200	1,599,200	20,000	1,619,200
1980	492,694	1,618,461	21,932	1,640,393
1981	499,024	1,670,783	22,907	1,693,690
1982	504,576	1,718,287	23,801	1,742,088
1983	511,007	1,760,352	24,777	1,785,129
1984	505,507	1,786,381	25,049	1,811,430
1985	504,439	1,811,636	25,427	1,837,063
1986	500,090	1,827,456	25,774	1,853,230
1987	492,049	1,836,180	26,430	1,862,610
1988	479,719	1,831,479	26,716	1,858,195
1989	472,678	1,836,001	26,913	1,862,914
1990	468,139	1,856,721	27,677	1,884,398
1991	478,352	1,906,219	28,925	1,935,144
1992	495,279	1,971,436	29,939	2,001,375
1993	508,388	2,035,156	31,547	2,066,703
1994	512,684	2,083,030	34,242	2,117,272
1995	518,958	2,132,829	37,371	2,170,200
1996	527,643	2,184,208	39,974	2,224,182
1997	536,678	2,240,441	42,530	2,282,971
1998	540,893	2,293,963	44,690	2,338,653
1999	548,848	2,357,348	47,108	2,404,456
2000	555,446	2,415,859	48,937	2,464,796
2001	561,413	2,469,825	50,874	2,520,699
2002	557,638	2,500,859	52,535	2,553,394
2003	555,865	2,524,797	53,063	2,577,860
2004	555,991	2,552,607	53,254	2,605,861
2005	557,917	2,586,568	53,866	2,640,434

Source: U.S. Census Bureau, 2006.

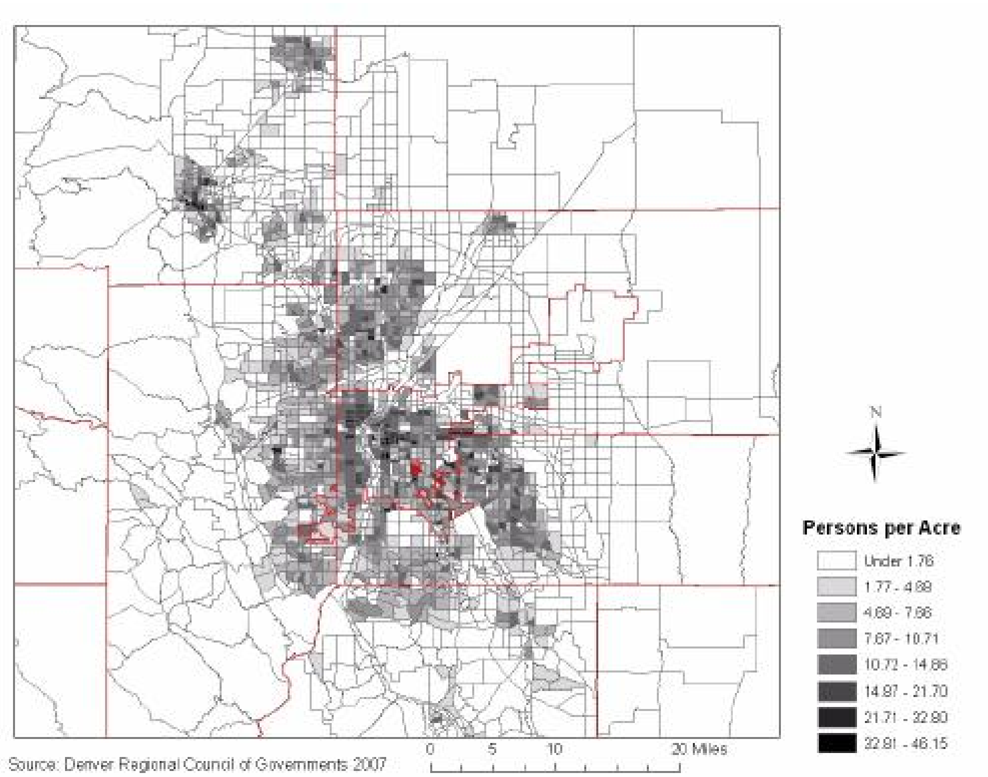


Figure 56 Denver MSA: population density by transportation analysis zone (2005)

The examination of population and employment growth and distribution indicates that Denver is a growing area and a decentralized one. But it is also an area where much decentralized activity, particularly employment, occurs in clusters or along corridors. The distribution of population and employment has important implications for transit structure and suggests the use of a decentralized or multidestination grid supplemented by radial lines in corridors such as the southeast. The authors discuss these issues in more detail later in the case study.

Institutions and Key Actors

In the Denver MSA, two regional-level public agencies play an important role in transit planning and policymaking: Denver Regional Council of Governments (DRCOG) and Denver Regional Transportation District (RTD). State-level agencies, including the Colorado Department of Transportation (CDOT), have also played roles in transit system development at various times in the region's history. Private sector entities have played important roles at particular moments, with employer groups serving as important champions of light rail transit at particular moments in the region's history.

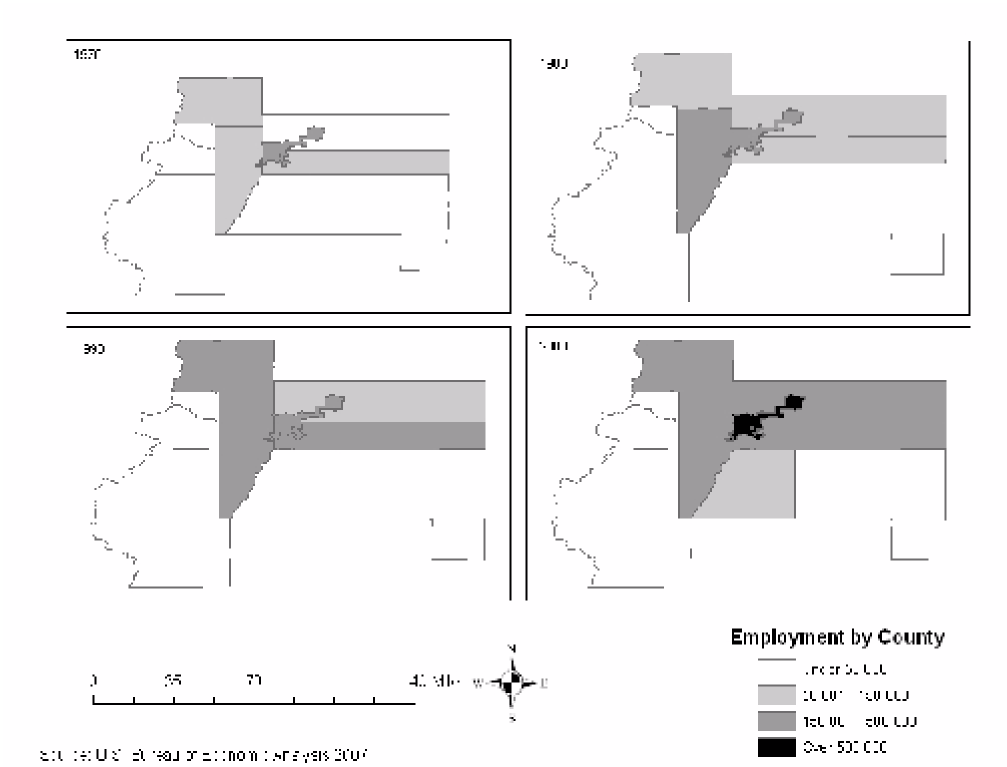


Figure 57 Denver MSA: employment by county (1970–2000)

Table 47 Employment in the Denver metropolitan area (1970–2000)

Year	Denver County			MSA Core Counties (7 counties)	Other MSA Counties (4 counties)	Total MSA (11 counties)
	Denver CBD	Outside Denver CBD	Total			
1970	42,281	345,996	388,277	617,783	4,751	622,534
1971	43,930	356,891	400,821	651,248	5,310	656,558
1972	45,643	367,979	413,622	696,413	5,881	702,294
1973	47,423	390,968	438,391	753,557	5,359	758,916
1974	49,273	381,633	430,906	767,143	5,526	772,669
1975	51,194	354,471	405,665	769,629	5,684	775,313
1976	53,191	358,023	411,214	800,621	6,495	807,116
1977	55,265	370,896	426,161	848,631	7,239	855,870
1978	57,421	395,478	452,899	915,657	7,996	923,653
1979	59,660	419,771	479,431	972,659	8,227	980,886
1980	62,000	426,158	488,158	1,007,445	8,720	1,016,165
1981	65,522	433,173	498,695	1,052,293	8,420	1,060,713
1982	69,243	435,432	504,675	1,084,990	8,516	1,093,506
1983	73,176	425,307	498,483	1,104,367	7,822	1,112,189
1984	77,333	438,157	515,490	1,172,092	8,838	1,180,930
1985	81,725	433,606	515,331	1,193,416	9,174	1,202,590

Year	Denver County			MSA Core Counties (7 counties)	Other MSA Counties (4 counties)	Total MSA (11 counties)
	Denver CBD	Outside Denver CBD	Total			
1986	86,367	412,215	498,582	1,186,640	9,480	1,196,120
1987	91,273	386,750	478,023	1,175,066	9,611	1,184,677
1988	96,457	381,632	478,089	1,204,286	9,008	1,213,294
1989	101,936	370,170	472,106	1,220,626	9,282	1,229,908
1990	107,773	365,210	472,983	1,243,808	9,454	1,253,262
1991	109,928	362,014	471,942	1,271,583	10,154	1,281,737
1992	112,127	362,509	474,636	1,293,774	13,511	1,307,285
1993	114,370	374,596	488,966	1,347,361	15,014	1,362,375
1994	116,657	377,827	494,484	1,402,570	16,851	1,419,421
1995	118,990	382,839	501,829	1,444,746	18,032	1,462,778
1996	121,370	390,484	511,854	1,495,464	18,400	1,513,864
1997	123,797	400,429	524,226	1,560,797	19,363	1,580,160
1998	126,273	418,535	544,808	1,624,447	21,293	1,645,740
1999	128,799	422,739	551,538	1,682,210	23,265	1,705,475
2000	131,320	436,792	568,112	1,754,056	24,605	1,778,661
2001	133,946	421,987	555,933	1,756,795	25,105	1,781,900
2002	136,625	400,724	537,349	1,727,853	26,285	1,754,138
2003	139,358	388,536	527,894	1,715,460	26,329	1,741,789
2004	142,145	387,191	529,336	1,741,155	26,803	1,767,958
2005	144,988	388,075	533,063	1,788,712	28,011	1,816,723

Source: U.S. Bureau of Economic Analysis, 2007; U.S. Census Bureau, 1970, 1980, 1990, 2000.

Denver Regional Council of Governments

The Denver Regional Council of Governments (DRCOG) is the metropolitan planning organization in the Denver metropolitan area. As the MPO, DRCOG is responsible for conducting the transportation planning process required as a prerequisite to obtaining federal highway and transit aid. DRCOG includes 52 member cities in nine counties; Elbert and Park counties are not included in the MPO. Each member government has an appointed representative, usually a local elected official, on the DRCOG board of directors. Denver, as a city and a county, has two representatives. The Governor of Colorado appoints three non-voting members to the DRCOG board.

Denver Regional Transportation District

Created in 1969, the Denver Regional Transportation District (RTD) is the public transit agency in the Denver metropolitan area. RTD plans and operates local bus, express bus, and light rail transit service in the MSA core. RTD is governed by a 15-member elected board. Board members represent geographic districts and serve four-year terms.

Transit Agency Modes, Fares, and Rider Profiles

Transit service in the Denver MSA is provided by the Regional Transportation District (RTD). RTD operates a combination of local and express bus service and light rail transit service; its service area is largely confined to the seven counties at the core of the Denver MSA. RTD's bus route structure resembles a modified grid (see Figure 59). Of 156 bus routes, 62 routes serve the Denver CBD; 79 of the 156 bus routes provide a connection to one or more light rail transit stations. CBD-serving bus routes account for 41% of bus vehicle miles, while non-CBD-serving bus routes account for 59% of bus vehicle miles. This distribution of bus routes and bus service between CBD-serving and non-CBD-serving routes might give the impression that the Denver CBD is the travel destination for a large proportion of RTD bus passengers. However, the authors' examination of RTD's rider profile indicates this is not the case, as they discuss later in the case study.

The LRT system follows a radial pattern. Two LRT lines originate in different parts of the CBD and extend south, merging to form a common line just south of the CBD. After several miles serving three stations, the common line diverges into a Southwest corridor leg and a Southeast corridor leg. The Southeast corridor leg has an additional spur extending for two stations to the east. These legs are shown on Figure 60.

Denver RTD's bus system operates five classes of routes. Local bus routes provide traditional, frequent-stop bus service within cities and between nearby cities (95 routes, 22 serve CBD). Express bus routes provide high-speed service between suburban locations and major destinations, such as the Denver CBD (25 routes, 21 serve CBD). Limited bus routes are limited-stop overlays on major local service routes (13 routes, 10 serve CBD). Regional bus routes serve long-distance travel between cities (18 routes, 8 serve CBD). Skyride bus routes provide service between major centers and the Denver International Airport (five routes, one serves CBD). Denver RTD's LRT system features six lines, connecting various combinations of end points on its multi-pronged system, operating on 10-30 minute peak and 15-30 minute off-peak, weekday service (see Figure 60). Denver's LRT system dates to the mid-1990s (see Table 48.

Table 48 Denver TRD rail segment openings since 1994

Year	Segment Length (miles)	Line	Section	Cumulative System Length (miles)
1994	5.3	C Line	30th–Downing—I-25–Broadway	5.3
2000	8.3	C Line	I-25–Broadway—Littleton/Mineral	13.6
2002	1.8	D Line	10th–Osage—Union Station	15.4
2006	19.3	T-Rex (Southwest Corridor) Project	I-24–Broadway—Lincoln;Belleview—Nine Mile	34.7

Source: Leroy Demery, *U.S. Urban Rail Transit Lines Opened From 1980*, October 18, 2005, 12–13.
Note: T-Rex (Southwest Corridor) Project opening planned for November 19, 2006.

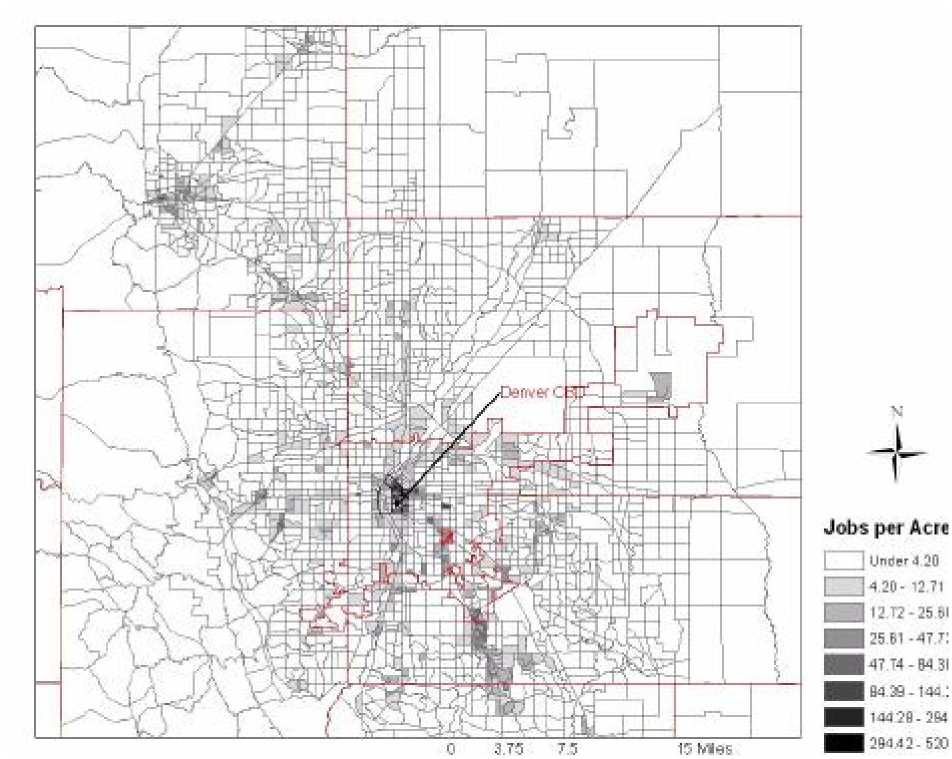


Figure 58 Denver MSA: employment density by transportation analysis zone (2005)

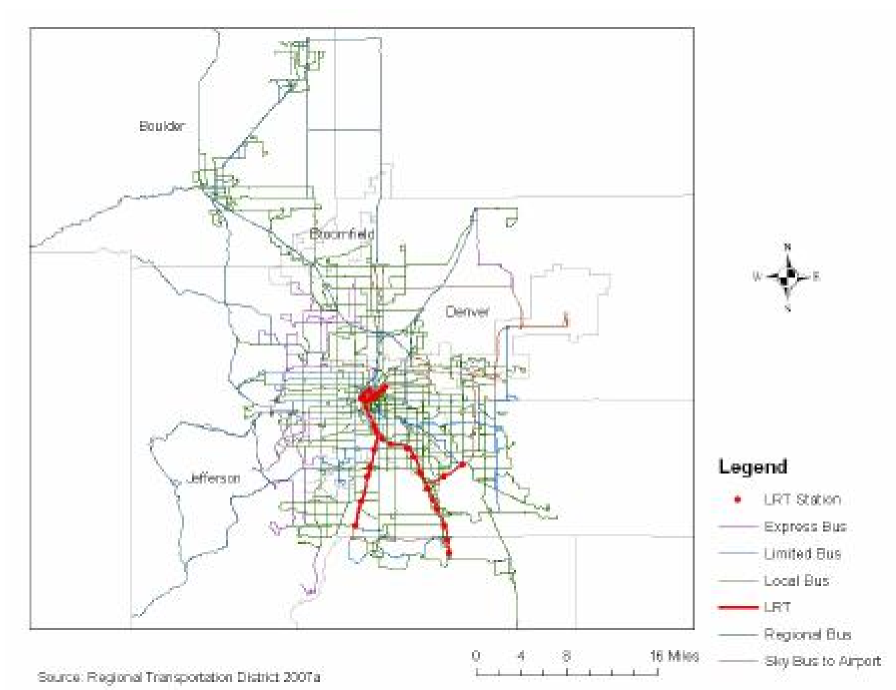


Figure 59 Transit system in the Denver metropolitan area (2007)

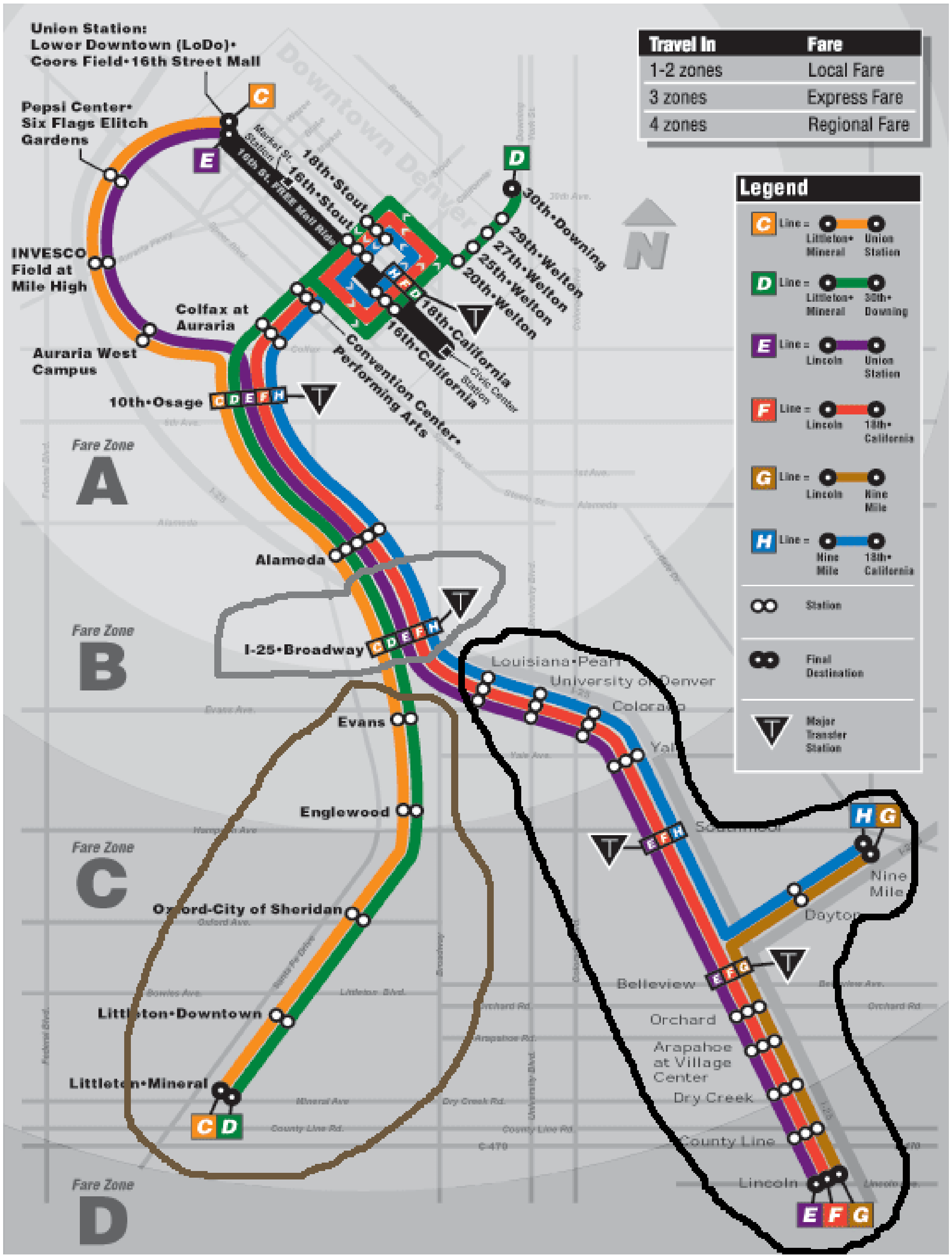


Figure 60 Denver RTD light rail transit lines

Source: Denver Regional Transit District, 2007

In the core of the metropolitan area, the 16th Street Transit Mall is an important element in the transit system (see Figure 60). The mall is served by a high-frequency, high-capacity, fare-free shuttle (75 second peak service, 3 to 4 minute off-peak service) that runs between two stations, which are the termini for CBD-bound express buses. The mall also intersects both

CBD prongs of the light rail system. The shuttle buses are hybrid electric vehicles that are 45 feet long with three doors; the low-floor buses can carry 100 passengers. These buses stop every block on the mall. According to one interviewee, the mall shuttle is the primary way people move around downtown. This person noted that noon-time travel activity is just as large as peak-period activity on the mall shuttle.

The study's interviewees characterized the transit mall as being extremely effective.[143] One contact reported that the mall has had a positive effect on downtown development, and is popular with both the City of Denver and the downtown business improvement district. While downtown development was a key focus of the mall investment, so was removing express buses from CBD streets. According to the interviewees, the mall shuttle allowed RTD to reduce operating expenses on express bus routes by truncating the most congested (and time-consuming) parts of these CBD-bound routes: the portions in the downtown. RTD used the operating savings from truncating the express routes to operate the mall shuttles. Removing diesel express buses from central downtown streets also pleased downtown interests, who objected to their noise and pollution.

RTD Fares

RTD has a fare structure that differs based on the type of service being used.[144] RTD local bus, limited bus, express bus, and regional bus operate with a flat fare system. As of October 1, 2007, the adult cash fare for local bus and limited bus is $1.50. The adult cash fare for express bus is $2.75. The adult cash fare for regional bus is $3.75. Sky ride bus services use a distance-based fare system with adult cash fares varying between $6.00 and $10.00. LRT service features a proof of payment, barrier free zone-based fare system, with adult cash fares varying between $1.50 and $3.75. The proof of payment fare technology allows passengers to board and alight from all doors on light rail trains, facilitating large transfer movements at intermediate stations.

RTD offers discounted fares to: senior citizens; the disabled; children; participants in its employer, neighborhood, and university-based Eco Pass programs; and individuals who purchase multi-ride tickets, day passes and monthly passes. Transfers are free, but must be issued at the time the fare is paid. Transfers are valid for one hour after the rider reaches the end of the trip during which the transfer was issued.

RTD Rider Profiles

In 2005, RTD hired a consultant who conducted a survey of 2,892 bus patrons, and the results of this survey allow us to develop a profile of RTD bus riders.[145] Table 49 describes the demographics of all RTD bus patrons and by type of bus service. The majority of bus riders on all services were female. RTD serves a mix of transit dependent (captive) and choice riders. Overall, most RTD bus riders (60%) are choice riders. Choice riders make up an overwhelming share of all express bus and regional bus riders, which is not surprising given the nature of these commuter-oriented services. However, choice riders are also the majority of local riders, except in the Longmont area northeast of Boulder. Local routes serve a lower-income ridership than do the express and regional routes.

Interestingly, although most RTD bus riders use the service to make work trips, the majority of commuters were bound for destinations outside the Denver CBD (see Table 50). Only in the case of express bus patrons did a majority of commuters use the service to reach destinations in the Denver CBD. This information indicates that a large share of the riders using CBD-serving local, limited, and even regional or express bus routes are either alighting at stops outside the CBD or are transferring to other services to reach non-CBD destinations. Stop-based boarding and alighting data could be used to test these suggestions, but such data were not available for this study.

Table 49 Demographics of RTD bus riders

Survey Category	Response	Total Percent	Type of Bus Service				
			Denver Local Percent	Boulder Local Percent	Longmont Local Percent	Express Percent	Regional Percent
Gender	Male	45	45	46	45	38	45
	Female	55	55	54	55	62	55
Transit Dependent	Yes	40	46	30	60	8	11
	No	60	54	70	40	92	89
Income	Under $15,000	26	28	26	42	3	10
	$15,000 to $24,999	19	21	17	28	4	10
	$25,000 to $34,999	16	18	12	12	10	5
	$35,000 to $49,999	14	14	12	6	17	15
	$50,000 to $74,999	13	12	15	5	25	22
	$75,000 to $99,000	6	4	10	6	22	15
	$100,000 or more	6	4	8	0	21	24

Source: The Howell Research Group, *2005 Bus Costumer Satisfaction and Trip Characteristics*, Regional Transportation District of Denver, February 2006, 59, 62.

Most RTD bus riders are regular users of the RTD transit system (see Table 51). RTD defines regular riders as those who ride public transit one or more times a week. Nearly one quarter of bus riders consider themselves regular riders of both bus and LRT services. Less than one-sixth of bus riders consider themselves non-regular transit riders.

Table 50 RTD bus use by trip purpose

Trip Purpose	Total Percent	Type of Bus Service				
		Denver Local Percent	Boulder Local Percent	Longmont Local Percent	Express Percent	Regional Percent
Work in downtown Denver	13	11	1	0	54	26
Work outside downtown Denver	53	54	53	37	41	54
School/college	8	7	19	16	4	8
Social/recreation	8	9	9	9	1	5
Shopping/eating out	8	9	9	28	*	2
Medical appointment	5	5	5	10	*	2
Personal business	4	5	3	1	*	2
Other	1	1	1	0	0	1

Source: The Howell Research Group, *2005 Bus Customer Satisfaction and Trip Characteristics*, Regional Transportation District of Denver, February 2006, 15.

* Less than 1%

Table 51 Riding habit of RTD bus riders

Frequency	Total Percent
Regular bus rider only	58
Regular bus and light rail rider	23
Regular light rail rider only	3
Non-regular rider	15

Source: The Howell Research Group, *2005 Bus Customer Satisfaction and Trip Characteristics*, Regional Transportation District of Denver, February 2006, 52

In the spring of 2006, the same consultant surveyed 410 light-rail transit riders and the results of this survey allow us to develop a profile of RTD LRT riders.[146] Compared to bus riders, LRT riders are more balanced between males and females, have higher incomes, and are less likely to be transit dependent, or captive, riders (see Table 52).

More than half of all LRT riders use the system for work trips; slightly more than half of these commuters use it to reach employment in the Denver CBD (see Table 53). Trips to educational institutions represent the next largest share of LRT trips. Many of these riders are undoubtedly using the system to access the Auraria educational complex in downtown Denver. Most LRT riders are regular users of the RTD transit system, with just under half describing themselves as regular users of both bus and LRT modes (see Table 54).

Table 52 Demographics of RTD light rail riders

Survey Category	Response	Total Percent	Type of Rider	
			Captive Percent	Choice Percent
Gender	Male	51	59	48
	Female	49	41	52
Transit dependent	Yes	22	100	0
	No	78	0	100
Income	Under $15,000	18	46	9
	$15,000 to $24,999	13	28	9
	$25,000 to $34,999	7	10	6
	$35,000 to $49,999	15	10	17
	$50,000 to $74,999	18	4	23
	$75,000 to $99,999	12	3	15
	$100,000 or more	16	0	22

Source: The Howell Research Group, *Spring 2006 Light Rail Customer Satisfaction and Trip Characteristics*, Regional Transportation District of Denver, July 2006, 47–48, 50.

Table 53 RTD light rail transit use by trip purpose

Trip Purpose	Total Percent
Work in downtown Denver	29
Work outside downtown Denver	27
School/college	15
Social/recreational	12
Shopping/eating out	5
Medical appointment	5
Personal business	4
Business meeting	2
Other	1

Source: The Howell Research Group, *Spring 2006 Light Rail Customer Satisfaction and Trip Characteristics*, Regional Transportation District of Denver, July 2006, 13.

Table 54 Riding habit of RTD light rail transit riders

Frequency	Total Percent
Regular bus rider only	31
Regular bus and light rail rider	44
Regular light rail ride only	5
Non-Regular rider	20

Source: The Howell Research Group, *Spring 2006 Light Rail Customer Satisfaction and Trip Characteristics*, Regional Transportation District of Denver, July 2006, 42.

Regional Transit Vision and Its Evolution

The study's interviewees provided detailed information about the evolution of the regional transit vision in the Denver metropolitan area.[147] Since the time of RTD's creation in 1969, a primary focus of regional transit planning has been the creation of a rapid transit system to provide service throughout the metropolitan area. According to the interviewees, planners and policymakers have often viewed the bus system as secondary to rapid transit; this was particularly the case during the RTD's early years.

When the effort to create a regional personal rapid transit (PRT) system failed in the mid-1970s, the region began pumping money into the bus system without a clear plan of what they intended to accomplish. Costs, if not ridership, escalated rapidly. The original rapid transit focus dated from RTD's creation in 1969. After four years of study, RTD presented a plan calling for the development of a personal rapid transit (PRT) system on a roughly grid pattern throughout the metropolitan area. Voters approved a ½% sales tax to support RTD and its rapid transit system plan.

Where rapid transit planning was systematic and thorough, the interviewees characterized bus system planning as very ad hoc during this period. RTD inherited the somewhat run-down Denver Metro Transit bus system in 1973–1974, and spent much of the revenue raised from the sales tax replacing old buses and adding service to some existing bus routes. No route changes were made at this time. Buses were irrelevant to the larger regional vision focused on rapid transit.

By the time Denver was ready to apply for a federal funding match to develop its PRT system, the federal government's attitude toward PRT had changed from support to opposition. The federal Urban Mass Transit Administration (UMTA) refused to provide funding for PRT. This federal decision forced Denver RTD to shelve its plan for PRT development, because local resources were not sufficient to fund the system. Instead, RTD began to focus on its bus system.

Prior to 1978, the RTD bus system was a radial system focused on the Denver CBD. In 1978, RTD restructured the system on a modified grid basis, which seemed appropriate to Denver's grid street pattern and was in keeping with the PRT proposal's grid concept. The principal objectives of bus restructuring were to save money on operating costs and improve overall system productivity. RTD removed buses from neighborhoods and placed service on arterial and collector roads. The restructuring was not a true grid, because any route that came within four miles of the CBD deviated from its arterial road to the CBD, adding as much as an hour to the travel time of passengers who did not have a destination in the CBD. Routes near other major activity centers also diverted from their assigned arterial or collector road to serve the major activity center. One of the study's interviewees said that these route diversions were introduced because RTD was concerned about requiring patrons to transfer to reach these centers. The other interviewee emphasized that the CBD is viewed as a particularly important travel destination for RTD riders, and so providing significant service to the CBD was an important objective for RTD.

The interviewees felt that the shift to a grid system generated service efficiencies, but also led to public resentment about the loss of one-seat rides between many origins and destinations. Public resentment eventually led to opposition to different RTD policies. Jack McCroskey, an RTD Board member, emerged as a leader of this opposition. He was instrumental in the passage of state legislation in 1982 that replaced the then-appointed RTD Board with the elected Board model (still in place today). One of the interviewees reported that the shift to an elected Board made RTD more sensitive to addressing constituent complaints, which led to a renewed focus on avoiding transfers wherever possible and many other compromises to the original grid service vision.

One of the interviewees observed that RTD oversold the grid concept, which led to low-density suburbs demanding fixed-route service on a grid pattern. RTD eventually backed away from the pure grid to a more multidestination system focused on key timed-transfer points. RTD developed major trunk lines to be the backbone of the timed-transfer system. One of the interviewees noted that RTD implemented these changes in service philosophy without publicly advertising them, because suburban interests opposed the loss of grid-based service.

Another outgrowth of the public resentment over bus restructuring was the defeat of a 1980 sales tax effort to fund a new light rail transit system plan. One interviewee noted that most RTD Board members interpreted the vote as an anti-rail vote, whereas this individual felt that lingering resentment about the bus restructuring was to blame.

Over the next several years, local policymakers and planners debated between investing in LRT or buses as the backbone for Denver's regional transit system. As time passed, concern emerged about the inability of CBD streets to handle all the buses being run to the two stations at the ends of the 16th Street transit mall. The street capacity problem led RTD away from buses (including BRT) as a regional transit strategy and back to LRT. One interviewee noted that pro-rail sentiment also began to emerge in the local business community, both in the Denver CBD and in places like the southeast corridor. These business interests championed construction of rail transit on right of way that had been acquired for development of a busway.

RTD began construction of its 5.3-mile LRT starter line using sales tax money from the state. One interviewee noted that RTD viewed LRT construction as a way of regaining political strength after a series of difficult events, including the earlier bus restructuring, a failed LRT initiative in the CBD to Stapleton Airport corridor, and legislatively-directed forced privatization of half its bus service. The other interviewee noted that RTD used the starter line to specifically build support for LRT development in Denver. This person observed that RTD used the starter line to prove that LRT could work, fit in with Denver's urban fabric, and attract choice riders from automobiles. The starter line exceeded initial ridership projections, became very popular, and led to three subsequent LRT system extensions. RTD is presently using light rail a framework for their bus system in the south. It appears that commuter rail will serve a similar function in the part of the region north and east of the CBD. The LRT lines allowed RTD to truncate some bus routes as feeders into the LRT stations, thus increasing system productivity and reducing overall operating cost.

According to the study's interviewees, the present regional vision for transit is a combined bus-rail vision to provide service to the entire Denver metropolitan area. The regional vision is expressed in the FasTracks package that includes 119 miles of combined LRT system expansion and commuter rail. This initiative, funded by a 0.6% dedicated transit sales tax, was passed in November 2004. The RTD's heavy reliance on sales taxes to fund service means that geographic equity concerns affect the definition of the regional vision and decisions about service provision.

The Denver Union Station is envisioned as the eventual hub for a multimodal transit system. Union Station will serve commuter rail to the north and LRT to the south. All but one fixed guideway service will connect to Union Station.

Regional Transit System Structure and Function

Denver RTD's present transit system is a radial rail system, with two major access routes into downtown and legs (or corridors) to the southwest and southeast, overlaid on a modified bus grid (see Figure 59). The LRT itself involves multiple routes connecting most combinations of the two northern and three southern terminal points (see Figure 60), a concept that is, according to one interviewee, inspired by Berlin's S-Bahn. RTD inherited a hodge-podge of municipal and private bus services, most of which focused on the Denver CBD because that was the strongest ridership market. RTD thus inherited a radial system, but gradually transformed it to a modified grid (as discussed earlier). Local buses operate largely on a grid, and crosstown buses also follow a grid but deviate into major centers such as the CBD.

According to the study's interviewees, LRT development has led to a truncating of some premium express routes, but has not affected local or crosstown services. According to one interviewee, one benefit of the original starter line was the ability to truncate some of RTD's express, premium, commuter services at the end of the light rail line and force a transfer from bus to rail. This person suggested that this change gave bus patrons more reliable travel time to the CBD, and led to improved travel times for most riders because LRT is grade separated near the Denver CBD. The service savings from truncating these buses allowed RTD to improve headways on the shortened segments of a number of these bus routes.

The same contact noted that similar service changes have been implemented as LRT has been extended. Many premium peak-period services have been transformed into crosstown all-day routes. Some of these routes have strong off-peak ridership. The most successful restructured routes tend to be located in higher density areas with grid streets, while the less successful routes tend to be in lower density areas with curvilinear streets.

The original light rail line connected largely residential areas in the southwest part of the region with jobs in the CBD. In contrast, the recently opened line (and its spur) to the southeast run along a rapidly-growing, job rich suburban corridor. These two new light rail extensions offer patrons the ability to get to employment and other destination activity not only in the CBD, but in the important southeastern corridor as well. One idea underlying the truncation of CBD-oriented commuter buses at outlying light rail stations was to open up new destinations reachable by transit to people living in the outer suburbs.

One of the interviewees noted that RTD learned some important lessons as part of the bus restructuring process. He said people using premium commuter services were most resistant to change, and used the example of Parker, an outer ring suburb that is part of the new Southeast LRT corridor, to illustrate this point. RTD had always had regional premium park-and-ride-based service to the CBD in this area, but these services provided only a few trips to the CBD during the morning and a few return trips in the afternoon. When LRT opened, RTD restructured this service into an LRT feeder with two-way, all-day service. Users would be able to travel any time of the day not only to the CBD but to any other destination reached by the light rail routes. The study's contact said there was intensive public resentment over this service change. Because of the transfer and because of the light rail trains making intermediate stops, these particular riders had a slower trip on LRT than when they had previously used the bus, and they were upset about it. RTD was pressured to restore some parallel bus service to the CBD. The interviewee said RTD had hoped to gain some ridership to suburban office parks along the Southeast LRT line as a result of service restructuring, and some such suburban-oriented ridership was beginning to emerge.

Denver RTD has also implemented innovative services, including call-and-ride service in low-density suburban areas. These services replace fixed-route bus service. One of the interviewees said RTD has increased ridership and reduced operating expenses using this new type of service to replace fixed-route service in some areas.

Denver RTD also faces some interesting service challenges, particularly in getting people to and from LRT stations located alongside freeways. Denver RTD developed its most recent 19-mile, $870 million LRT line as part of the joint highway-LRT TREX project with Colorado Department of Transportation (CDOT). Two LRT stations lie in the freeway median. The LRT alignment generally runs on the west side of the freeway. The difficulty is that most employment lies to the east of the freeway. RTD's response has been to provide pedestrian bridges to the LRT stations. Both interviewees report that people use the pedestrian bridges to access the LRT, but that more people doing so are traveling to and from park and ride lots than traveling to and from the adjacent office parks. RTD has restructured former express bus service to feed these stations. In less dense areas, RTD relies on demand responsive, call-and-ride service to connect people to the stations.

Transfers

The study's interviewees viewed transfers as essential to the operation of RTD's system, and characterized the network as having been designed to optimize transfers, which are free to the rider. Both contacts noted that transfers should be as smooth as possible for the rider, so the system can work effectively. One interviewee opined that a one-seat ride would be more desirable, but that it was unrealistic to attempt such service given the dispersed pattern of origins and destinations. For this person, transfers are a necessary evil for the system's effective operation.

Transfers are a common, and growing, phenomenon for RTD patrons. One of the interviewees estimated that about 51% of all RTD riders transferred during their trip, up considerably from a transfer rate that was about 20% in the mid-1970s.[148] Table 55 shows that more than half of all bus riders (55%) made at least one bus-to-bus transfer during their trip. Denver local bus riders were the most likely to make a bus-to-bus transfer, while express bus riders were least likely to make a bus-to-bus transfer. According to one interviewee, bus-to-bus transfer activity is higher in the central part of the system. About one-sixth of bus riders used light rail transit for a segment of their trip. Among light rail transit patrons, just under half (45%) made a bus-to-rail or rail-to-bus transfer for part of their trip.[149]

Table 55 Transfer rates on RTD bus system

Transfer Category		Total Percent	Type of Bus Service				
			Denver Local Percent	Boulder Local Percent	Longmont Local Percent	Express Percent	Regional Percent
Number of bus transfers required	None	45	39	63	57	69	66
	One	41	44	28	31	24	29
	Two or more	15	17	9	12	6	5
Used light rail for a portion of the trip		16	19	3	6	18	4
Used 16th Street Mall Shuttle for a portion of the trip		17	18	3	4	33	21
Used SkyRide for a portion of the trip		2	2	3	3	1	1
Used Call-n-Ride for a portion of the trip		2	2	2	9	1	2

Source: The Howell Research Group, *2005 Bus Customer Satisfaction and Trip Characteristics*, Regional Transportation District of Denver, February 2006, 25.

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

Since 1984, transit riding habit (measured as passenger miles per capita) has increased more than 13% in the Denver metropolitan area (see Figure 61). During the same period, service productivity (measured as passenger miles per vehicle mile, or load factor) has decreased nearly 19% (see Figure 62). During this time, the metropolitan area has experienced ridership and service productivity peaks and valleys. During the mid-1980s, both ridership and service productivity declined. The ridership increases and productivity improvements in the more recent part of the trend lines correspond to LRT extensions.

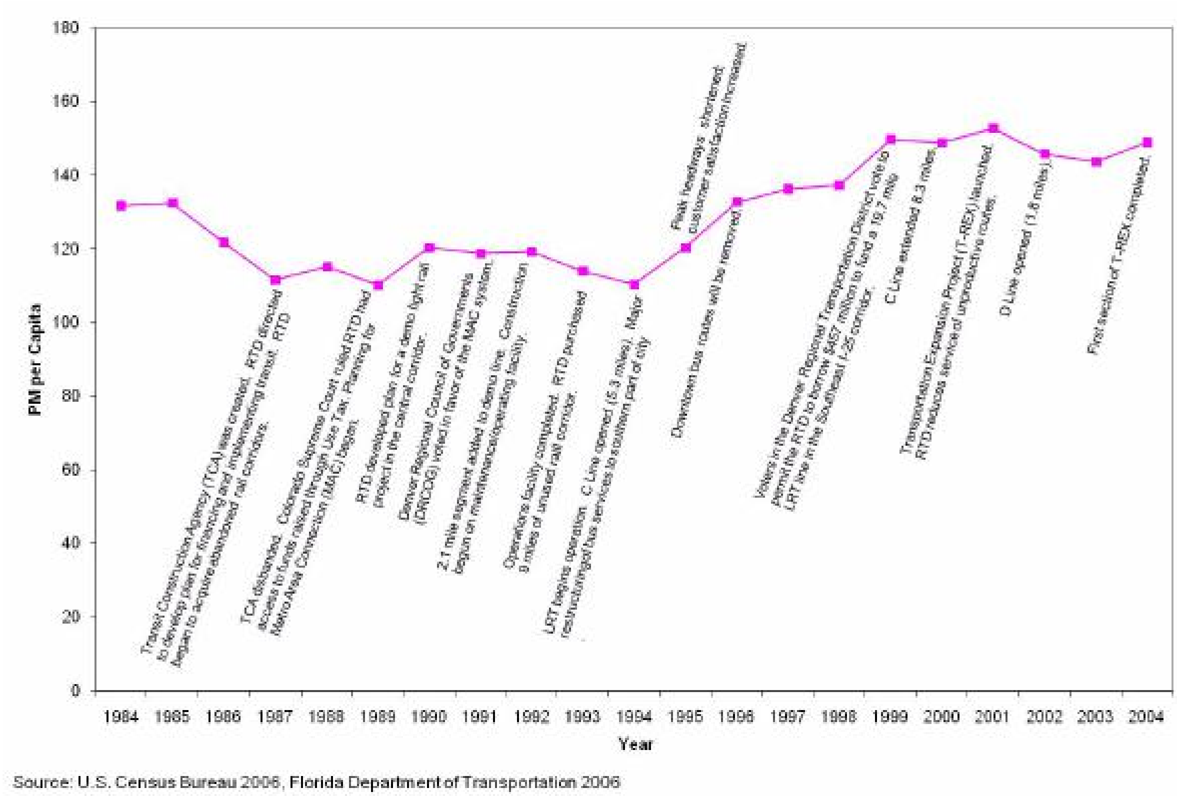


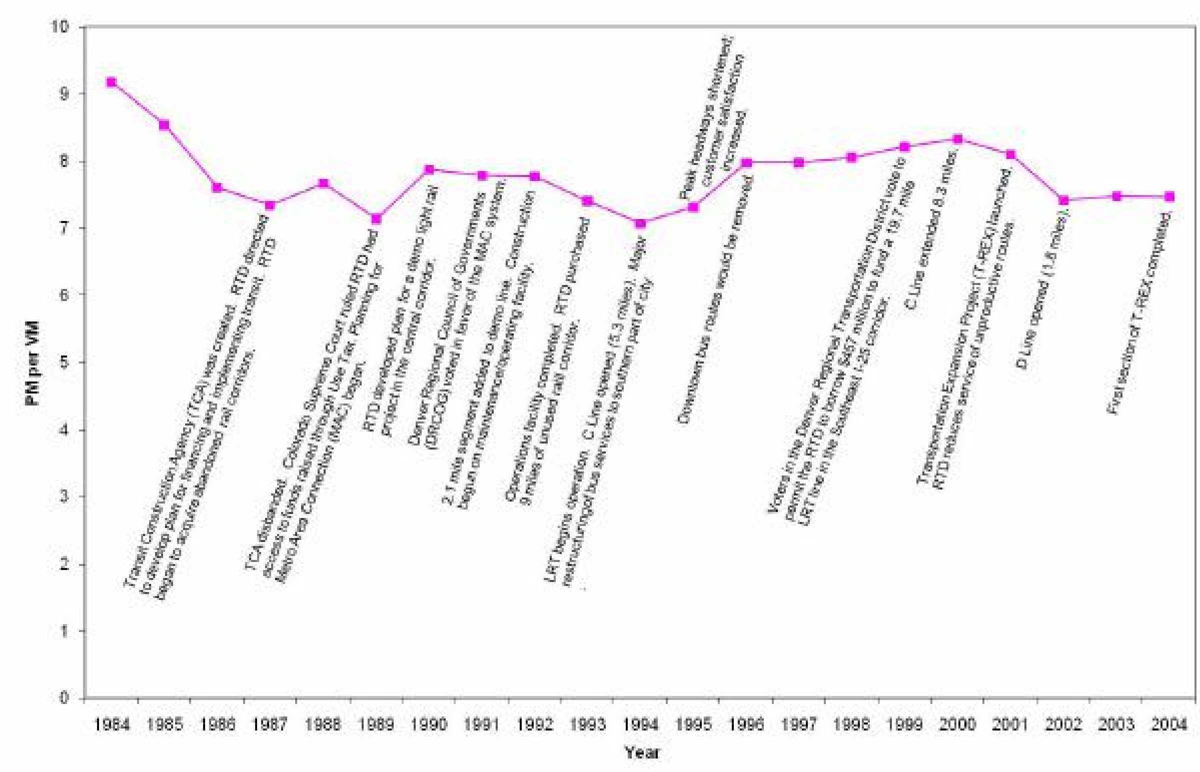
Figure 61 Denver MSA riding habit (passenger miles per capita) (1984–2004)

RTD System Ridership and Productivity Trends

Table 56 reports ridership on RTD's fixed-route service from 1984 to 2004. The table indicates that RTD is experiencing increased ridership on both its bus and light rail services. Bus ridership (measured as either passenger miles or unlinked passenger trips) has increased steadily since 2000, while rail ridership (on both measures) has increased significantly due to rail segment openings in recent years that have lengthened the system. One interviewee said that employment growth and population growth in the metropolitan area are key contributors to the ridership increase.

Table 57 reports average trip lengths by bus and rail over period 1984 to 2004. These statistics result from dividing the passenger miles (reported in Table 56) by the unlinked passenger trips (reported in Table 56). The table shows that average bus trip lengths have been fairly stable since the late 1990s. The average rail trip length has increased as the rail system has expanded. The authors believe that the average rail trip length for 2001 is highly suspect, with the possibility that 2001's rail passenger miles are overstated.

The expansion of the rail system is also evident in the service statistics reported in Table 58. Rail vehicle miles have increased dramatically since 1999, as rail segments have opened. Bus vehicle miles have increased significantly since 1999 as well.



Source: Florida Department of Transportation 2006

Figure 62 Denver MSA load factor (passenger miles per vehicle mile) (1984–2004)

Table 56 Ridership on RTD fixed route transit services (1984–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	RDT Bus	RTD Rail	RTD Total	RTD Bus	RTD Rail	RTD Total
1984	238,633,127		238,633,127	50,738,777		50,738,777
1985	243,476,054		243,476,054	57,812,734		57,812,734
1986	225,806,845		225,806,845	53,546,971		53,546,971
1987	207,661,607		207,661,607	50,671,517		50,671,517
1988	213,990,815		213,990,815	51,240,618		51,240,618
1989	201,860,351		201,860,351	51,460,841		51,460,841
1990	219,245,504		219,245,504	53,084,821		53,084,821
1991	229,851,931		229,851,931	56,587,316		56,587,316
1992	238,649,357		238,649,357	58,865,608		58,865,608
1993	235,435,520		235,435,520	60,179,954		60,179,954
1994	231,046,037	2,633,282	233,679,319	61,476,822	964,590	62,441,412
1995	250,199,619	11,005,767	261,205,386	62,764,910	4,054,403	66,819,313
1996	283,685,911	11,539,229	295,225,140	65,378,977	4,108,636	69,487,613
1997	299,157,898	12,026,642	311,184,540	66,342,984	4,428,085	70,771,069
1998	269,756,265	13,055,603	282,811,868	59,818,013	4,806,895	64,624,908
1999	306,282,466	13,967,697	320,250,163	62,734,296	4,746,248	67,480,544

Table 56 Ridership on RTD fixed route transit services (1984–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	RDT Bus	RTD Rail	RTD Total	RTD Bus	RTD Rail	RTD Total
2000	338,931,794	28,222,709	367,154,503	70,041,406	6,675,202	76,716,608
2001	321,402,408	63,519,678	384,922,086	70,466,713	9,080,578	79,547,291
2002	328,092,805	44,577,670	372,670,475	69,681,281	10,429,572	80,110,853
2003	325,031,014	45,495,136	370,526,150	67,107,872	10,635,977	77,743,849
2004	344,959,881	43,341,343	388,301,224	71,338,116	10,028,459	81,366,575

Source: Florida Department of Transportation, 2006.
Note: The authors believe the year 2001 rail passenger miles statistic is very suspect.

Table 57 Average trip lengths (RTD) (1984–2004)

Year	Average Trip Length (miles)		
	RTD Bus	RTD Rail	RTD Total
1984	4.70		4.70
1985	4.21		4.21
1986	4.22		4.22
1987	4.10		4.10
1988	4.18		4.18
1989	3.92		3.92
1990	4.13		4.13
1991	4.06		4.06
1992	4.05		4.05
1993	3.91		3.91
1994	3.76	2.73	3.74
1995	3.99	2.71	3.91
1996	4.34	2.81	4.25
1997	4.51	2.72	4.40
1998	4.51	2.72	4.38
1999	4.88	2.94	4.75
2000	4.84	4.23	4.79
2001	4.56	7.00	4.84
2002	4.71	4.27	4.65
2003	4.84	4.28	4.77
2004	4.84	4.32	4.77

Source: Florida Department of Transportation, 2006.

Table 58 RTD fixed route transit service (1984–2004)

Year	Vehicle Miles		
	RTD Bus	RTD Rail	RTD Total
1984	26,019,647		26,019,647
1985	28,501,101		28,501,101
1986	29,693,728		29,693,728
1987	28,292,697		28,292,697
1988	27,895,648		27,895,648
1989	27,165,277		27,165,277
1990	25,831,662		25,831,662
1991	29,533,916		29,533,916
1992	30,705,818		30,705,818
1993	31,780,956		31,780,956
1994	32,907,273	132,383	33,039,656
1995	35,245,940	491,500	35,737,440
1996	36,440,766	576,400	37,017,166
1997	38,289,622	704,600	38,994,222
1998	33,352,407	718,000	34,070,407
1999	37,298,938	735,100	38,034,038
2000	42,490,850	1,565,100	44,055,950
2001	45,089,433	2,423,726	47,513,159
2002	46,851,107	3,433,550	50,284,657
2003	45,565,999	3,995,458	49,561,457
2004	48,053,736	3,904,584	51,958,320

Source: Florida Department of Transportation, 2006.

Table 59 relates the ridership data reported in Table 56 with the service data reported in Table 58 to report service productivity (measured as passenger miles per vehicle mile, or load factor). The table shows that service productivity has declined since 1984. The declines found here in Denver are consistent with the national trend toward reduced service productivity. Bus productivity has stabilized since 2001, indicating that RTD is operating a mix of services that is attracting a stable ridership. On the rail side, productivity has declined from the very high numbers associated with operation of the 5.3-mile starter line to a fairly stable load factor of between 11 and 12 passenger miles per vehicle mile over the past few years. The rail productivity statistic for 2001 is suspect due to concerns about the accuracy of year 2001 passenger miles data.

Denver's rail productivity today is considerably lower than that of most other metropolitan areas in this study. A possible explanation is the large number of rail routes (six) that Denver RTD operates over a relatively uncomplicated track configuration, as shown earlier in Figure 60 There is a unique route connecting most pairs of origins and destinations. The apparent objective is to avoid rail passengers having to transfer from one branch of the rail system to the other, but most other systems would have operated fewer routes requiring some rail passengers to transfer between rail routes. After it opened its first light rail line but before it built branches, Denver RTD operated only one rail route over its track configuration and experienced rail productivity similar to that of other metropolitan areas in the study, as reflected in Table 59, through 2001.

Table 59 RTD service productivity (1984–2004)

Year	RTD Bus	RTD Rail	RTD Total
1984	9.17		9.17
1985	8.54		8.54
1986	7.60		7.60
1987	7.34		7.34
1988	7.67		7.67
1989	7.43		7.43
1990	8.49		8.49
1991	7.78		7.78
1992	7.77		7.77
1993	7.41		7.41
1994	7.02	19.89	7.07
1995	7.10	22.39	7.31
1996	7.78	20.02	7.98
1997	7.81	17.07	7.98
1998	8.09	18.18	8.30
1999	8.21	19.00	8.42
2000	7.98	18.03	8.33
2001	7.13	26.21	8.10
2002	7.00	12.98	7.41
2003	7.13	11.39	7.48
2004	7.18	11.10	7.47

Source: Florida Department of Transportation, 2006.

RTD Bus Route Performance Analysis

In an attempt to better understand which kinds of services and markets are growing and which ones are declining, the authors obtained individual route ridership and service statistics for all RTD bus routes.[150] Available ridership data included average weekday, Saturday, and Sunday unlinked passenger trips; neither passenger mile nor linked passenger trip data were available on a route-by-route basis. Available service data included average weekday, Saturday, and Sunday revenue miles, revenue hours, vehicle miles, and vehicle hours.

The authors selected two measures of route performance: trips per revenue hour and trips per revenue mile. They examined these measures for the average weekday, average Saturday, and average Sunday for the five classes of routes that RTD operates (local, express, limited, regional, and sky[ride]). They also differentiated between CBD-serving and non-CBD-serving routes. The authors excluded the mall shuttle from the performance analysis.

Table 60 presents the results of the study's bus route performance analysis. The table reports the performance of the median route within each group. The table shows that, when routes are divided into CBD-serving versus non-CBD-serving routes, the CBD-serving median route consistently outperforms the median route for the non-CBD-serving group. However, many of the people using the CBD-serving routes are traveling to non-CBD locations, as noted in the earlier discussion of the rider profiles. More detailed examination of individual routes revealed that RTD has 68 bus routes that carry less than one trip per revenue mile. Of these, 56 are non-CBD-serving routes, while 12 are CBD-serving routes.

Table 60 RTD bus route performance

Route Type	Routes	Trips per Revenue Hour (median)			Trips per Revenue Mile (median)		
		Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
All routes	155	21.20	17.04	16.14	1.07	0.99	0.94
All non-CBD routes	94	16.56	15.19	14.75	0.82	0.70	0.67
Non-CBD local routes	73	16.60	14.66	17.16	0.93	0.81	0.80
Non-CBD express routes	4	19.00	n.a.	n.a.	0.47	n.a.	n.a.
Non-CBD limited routes	3	14.11	12.70	9.43	0.84	0.51	0.43
Non-CBD limited routes	10	16.52	17.46	14.04	0.61	0.61	0.55
Non-CBD sky routes	4	19.51	15.76	15.51	0.57	0.46	0.52
All CBD routes	61	26.59	18.59	17.93	1.41	1.27	1.18
CBD local routes	21	28.07	18.59	17.49	2.01	1.31	1.18
CBD express routes	21	26.42	12.73	n.a.	1.20	0.36	n.a.
CBD limited routes	10	32.20	47.95	31.59	2.03	3.04	2.25
CBD regional routes	8	19.15	18.07	20.45	0.73	0.60	0.72
CBD sky routes	1	17.28	15.91	12.50	0.57	0.51	0.40

Source: Calculated from Denver Regional Transit District 2007c, 2007d.
Note: Excludes Mall Shuttle

LRT Performance and Rail Station Entries

The authors also obtained light rail ridership and service statistics. These statistics are reported in Table 61. Unfortunately, they were unable to obtain these data on a line-by-line basis, which would enable comparison. However, the authors were able to obtain station-based boarding and alighting data (by direction) for all RTD light rail transit stations.

Table 61 RTD light rail transit performance

Service	Vehicle Runs	Passenger Trips	Revenue Miles	Vehicle Miles	Trips per Revenue Mile
Weekday	903	41,021	11,580	11,588	3.54
Saturday	641	22,158	8,362	8,367	2.65
Sunday	641	16,558	8,362	8,367	1.98

Source: Regional Transportation District 2007c, Regional Transportation District 2007d.

The station-based statistics show daily patronage as well as week day patronage in the morning and evening peak periods by direction and by boardings and alightings. The peak period figures are particularly useful, because they can be used to paint a conservative picture of the extent to which patrons are using the light rail line for non-traditional purposes (traveling entirely within the suburban zones during the morning peak, or traveling into them from the outside) in contrast to traditional purposes (in other words, commuting from suburban stations during the morning peak to outside of the suburban zone, presumably to the CBD). The all-day figures cannot be used for this purpose, because over the course of a 24-hour period most passengers repeat a journey that they made earlier in the day, but in the opposite direction. However, if one looks only at passengers during the morning peak, one generally sees only one half of a patron's daily travel and one can make inferences about origins and destinations.

For example, if one looks only at suburban stations as defined earlier in Figure 60 during the morning peak, one can infer that passengers who board southbound trains are non-traditional riders because they must alight at another suburban station. Passengers who alight from northbound trains at the suburban stations during the morning peak similarly must be non-traditional passengers. Southbound passengers who alight from trains at the suburban stations must be non-traditional riders, as well. The traditional passengers would be those boarding northbound trains at the suburban stations. Most probably are destined to the CBD, but not all are. About 10% of those passengers alight at the first station the two southern legs have in common.

These figures are conservative estimates of the number of passengers traveling for non-traditional purposes, because they count all passengers as headed to the CBD as working in the CBD. Some of these passengers may transfer to buses to travel beyond the CBD, and others may be traveling to the CBD for other purposes. Finally, the figures do not take into account mid-day, evening, or weekend riders, all of whom are non-traditional. Nonetheless, they reveal substantial non-traditional riding.

Table 62 summarizes the extent of usage of stations serving the job-rich Southeast LRT corridor, while Table 63 summarizes usage of stations serving primarily residential areas on the Southwest corridor of Denver RTD's light rail system. The usage is for an average January 2007 weekday morning peak period, which is defined as the period from 6:00 a.m. to 8:59

a.m. Both tables compare the strength of non-traditional patronage, composed of passengers destined to stations within these two suburban areas during the morning, with traditional passengers who begin their trips at suburban stations in the morning and travel outside of the two suburban areas, presumably to the CBD. Figure 60, shown earlier defines, the stations included in both corridors.

Table 62 RTD Southeast Corridor light rail transit boardings

Type of Boarding	Number	Percent
Total boardings	5,750	100
Traditional riders (Southeast to North)	3,817	66.38
Non-traditional riders (all)	1,933	33.62
Southeast to Southeast, northbound	422	7.34
Southeast to Southeast, southbound	589	10.24
Boarded at other points (north), destined to southeast	922	16.03

Source: Rynerson, 2007.

Note: Table reports passengers boarding LRT during morning peak from Southeast corridor stations or who boarded outside Southeast corridor but were destined to Southeast corridor stations (including branch to Nine Mile).

Table 63 RTD Southwest Corridor light rail transit boardings

Type of Boarding	Number	Percent
Total boardings	4,280	100
Traditional riders (Southwest to North)	3,380	78.97
Non-traditional riders (all)	900	21.03
Southwest to Southwest, northbound	198	4.63
Southwest to Southwest, southbound	161	3.76
Boarded at other points (north), destined to Southwest	541	12.64

Source: Rynerson, 2007.

Note: Table reports passengers boarding LRT during morning peak from Southwest corridor stations or who boarded outside Southwest Corridor but were destined to Southwest Corridor stations.

Table 62 reveals the existence of sizable non-traditional traffic that is destined during the morning peak to stations on the Southeast corridor, amounting to one third of the total morning peak boardings at Southeast corridor stations and stations outside of the Southeast corridor for passengers destined to the Southeast corridor. Somewhat more than half of this traffic is coming into the Southeast corridor from points north; somewhat less than half of this traffic is composed of patrons who both begin and end their rail journeys within the Southeast corridor. Not surprisingly, non-traditional traffic is less pronounced (but significant) on the Southwest corridor, that serves largely residential areas. Such traffic during the morning peak amounts to a little more than 20% of the morning boardings and alightings for Southwest corridor stations (see Table 63).

Some of the traffic that originates at stations within the two corridors during the morning peak and heads north is non-CBD related traffic, as well. A little more than 10% (796 trips) of this traffic alights at I-25 and Broadway, the first station beyond the point where the two corridors merge into a single trunk (see Figure 60). Some or all of these passengers presumably are destined to nearby destinations. Some passengers may transfer to southbound trains to reach more southerly destinations. More than 450 passengers board southbound trains at this station during the morning peak period.

Emerging and Declining Ridership Markets

The study's interviewees provided some information about emerging and declining ridership markets for RTD.[151] Both interviewees pointed to bus routes serving strip-commercial arterials as significant ridership routes. RTD provides all-day service on these routes, and patronage is sufficiently high that it exceeds RTD's performance criteria. Both interviewees emphasized, however, that ridership on these routes is lower than on routes in more traditional urban areas.

Both interviewees also pointed to reverse commute ridership as an emerging ridership market. One of the interviewees pointed in particular to reverse commute activity to the employment centers along the southeast light rail transit line. By contrast, there is little such activity along the southwest light rail transit line.

Finally, the interviewees noted that major trunk routes remain strong ridership carriers. One interviewee noted that many of these routes may eventually turn into bus rapid transit (BRT) type service.

By contrast, this same person noted that RTD is losing ridership on its half-hour headway collector route service. These tend to be the neighborhood-serving routes. The authors' contact suspects that people are passing up these routes in order to use more frequent nearby routes.

Another declining market is the neighborhood pick-up express route. These are routes that circulate through neighborhoods picking up riders before running as express service to the CBD. These routes are typically peak-only, half-hour headway services. One interviewee noted that people are abandoning these services for park-and-ride-based service that tends to be faster and more frequent.

Finally, one of the interviewees observed that gentrification is causing ridership decline on some all-day services in older residential areas. The new residents tend to have smaller household sizes, higher incomes, and greater vehicle availability than the residents they have replaced. This finding has enormous implications for transit agencies in many areas where core-area redevelopment is a major policy objective.

Transit and Development

The Denver area has used transit as a tool to promote development. Earlier, the authors discussed the sense of the study's interviewees that the transit mall had a positive effect on development in the Denver CBD. Contemporary interest focuses more on development tied to light rail transit. One of the interviewees pointed to development occurring around many rail stations. This contact characterized much of this development as transit-oriented development (TOD). Many communities in the Denver area are promoting TOD, and, according to the study's contacts, the developers have also bought into the TOD concept and pushed for TOD-supportive zoning in the southeast LRT corridor. The study's interviewees sense that TOD is generating transit patronage, but there has been no systematic evaluation of this issue.

As an example of in-place TOD, the interviewees pointed to the site of a former indoor mall (Cinderella City) in the city of Englewood that has been transformed into a mixed use development with offices, three-story apartments, and retail (including a Wal-Mart). One interviewee noted that this site has good pedestrian access and that people are accessing the site from the LRT station.

As an example of a future TOD, one of the study's interviewees pointed to a former industrial site at the Broadway/I-25 station in Denver. The site is zoned for mixed use and the development is planned to be high end. The contact characterized pedestrian access to the site as excellent.

Public Attitude Toward Transit

After the false starts of the 1970s and the public resentment over service restructuring in the late 1970s, Denver RTD focused on rebuilding its public support. The success of the initial 5.3-mile starter light rail transit line and the success of subsequent lines have been significant in the changing of public attitudes. The study's interviewees stated that the public is generally supportive of transit at this time. As evidence, they point to the November 2004 FasTracks vote. The 2004 success stood in stark contrast with a failed 1997 initiative that received only 40% support. In the intervening years, the Southwest line had opened and been viewed as a success, and local political leaders, including members of the Metro Mayors Council, became supporters of regional transit initiatives.

The same contact pointed to the heavy use of rail transit for special events (like sporting events and concerts). Special events users are not normally transit users, and this use represented their initial exposure to light rail. This interviewee senses that these riders have largely enjoyed their riding experience and have become supporters of light rail transit.

DISCUSSION

Unlike most of the study cities, the Denver area has a single agency that provides transit service: Denver RTD. This agency has developed a regional vision and implemented a service structure to achieve this vision. Denver possesses a truly regional transit system with a veneer of regional service, although its regional services are not presently the kinds of high-speed, high-frequency services needed to provide strong regional connectivity. The planned commuter rail service may or may not be a means of beginning to provide such service. Nevertheless, the authors' sense is that RTD is very responsive to the desires of its riders.

The authors' analysis indicates that RTD's service strategy is paying off in the form of increased ridership, particularly since light rail started, although service productivity, particularly for rail, is fairly low (albeit stable). Denver has twice the riding habit (ridership per capita), and the same service productivity, as Dallas, despite having both a smaller population and lower regional population density. Denver has the same riding habit as Atlanta, but half the service productivity. Unlike many other cities, there are no major employment centers outside the transit service area (see Figure 63).

The authors sense is that Denver might be providing a lot more service than its density of population and employment requires. Duplicative service appears to be an issue in Denver. The LRT features duplicative service that is provided in an attempt to facilitate point-to-point travel over a wide array of origins and destinations. In many cases, premium commuter service was retained, due to rider opposition to its termination, when rail opened in the same travel corridors. Overall, RTD's transfer rate is moderate, with more than half of bus riders and nearly half of rail riders transferring to complete their trips. However, this study's analysis indicates that there are more opportunities to rely on transferring, as opposed to point-to-point service, which RTD might choose to pursue.

The Denver CBD is the strongest downtown of all the cities the authors examined, largely due to its combined role as a major commercial and educational center. RTD provides a lot of service to downtown Denver, although the Denver CBD is not the dominant destination for most transit riders. RTD carries a sizeable share of non-traditional riders, including on LRT, and it serves a sizeable reverse-commute market in places like the southeast corridor. In this corridor, ridership is growing, and RTD enjoys the support of many business interests.

The authors sense is that rail has contributed positively to transit development in the Denver region, although it represents a smaller share of overall ridership than in cities like Atlanta and Dallas. LRT has facilitated multidestination system development by enabling some CBD express routes to be deleted and by serving non-CBD activity centers, although the multidestination concept existed in Denver prior to LRT's introduction. The development of LRT also helped RTD politically, as the agency was under stress at both the state and local level prior to rail implementation. LRT has been popular with business interests in both the Denver CBD and in outlying centers like the Southeast Corridor.

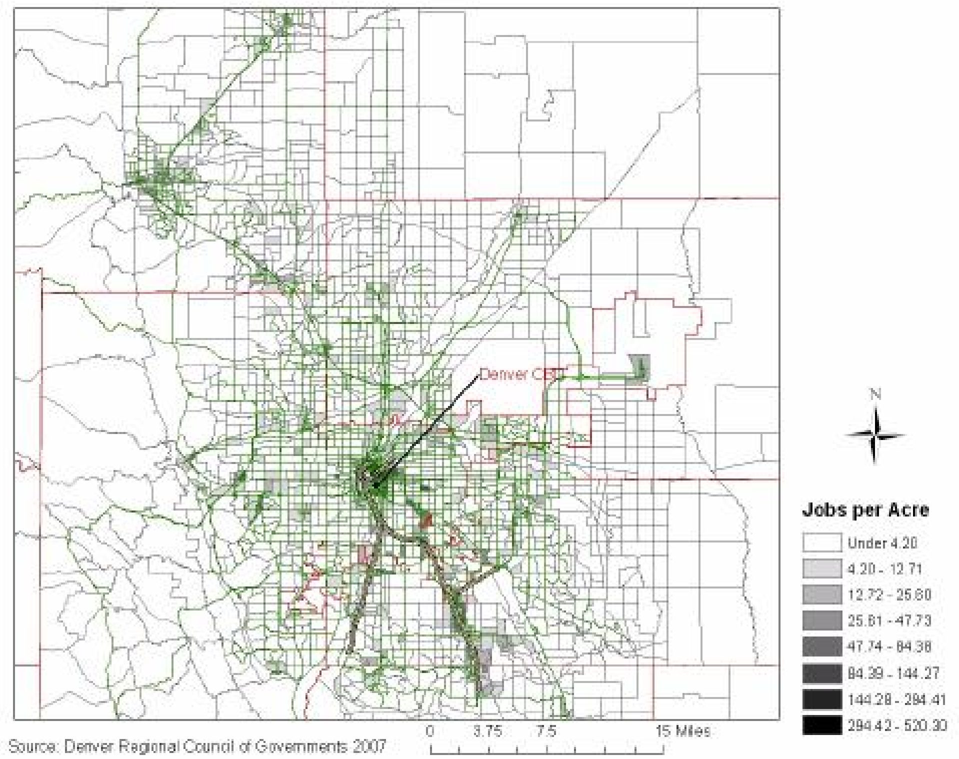


Figure 63 Denver transit system and its relation to employment (2005)

APPENDIX D
MIAMI, FLORIDA

SETTING

The Miami Metropolitan Statistical Area (MSA) consists of three counties in southeast Florida with a total land area of just over 5,100 square miles.[152] With 5.4 million persons in 2005, the Miami MSA ranks as the nation's 6th largest in population.[153] The Miami MSA's population density is just over 1,057 persons per square mile.

The three counties that comprise the Miami MSA are Broward, Miami-Dade, and Palm Beach (see Figure 64). These counties are bounded on the east by the Atlantic Ocean; the Everglades occupy the western portion of each county.

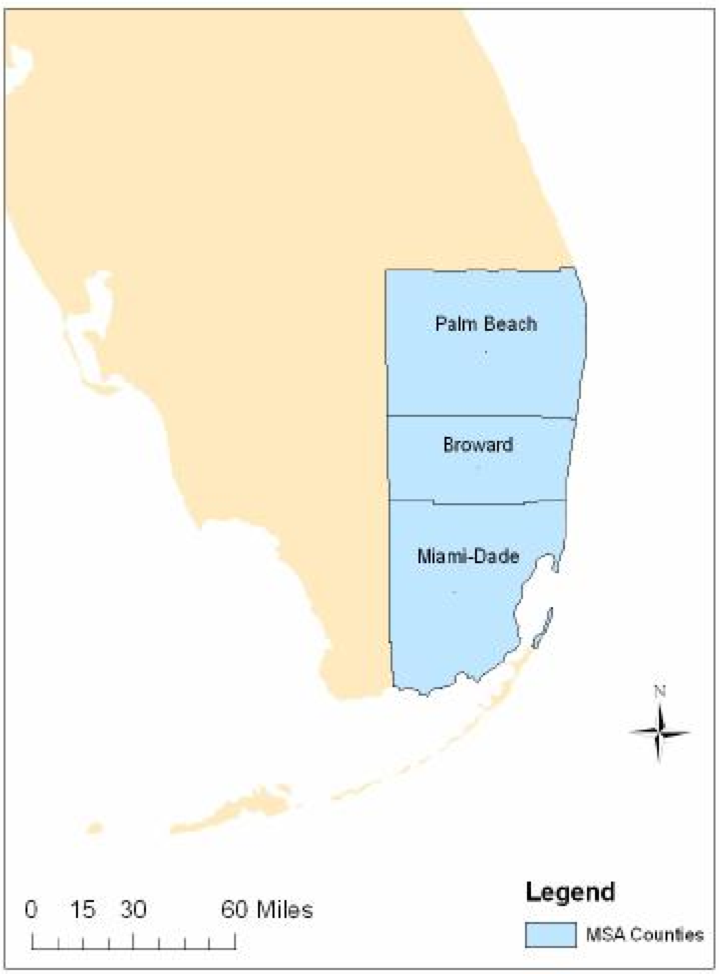


Figure 64 Miami metropolitan statistical area

Miami-Dade County contains Miami, the MSA's largest city; Broward County contains the city of Fort Lauderdale; Palm Beach County contains the city of West Palm Beach. Each county has its own public transit system, as discussed later in the case study. The authors' primary focus in the case study is Miami-Dade County, although they briefly discuss metropolitan area-wide transit issues.

Distribution of MSA Population

The Miami MSA is a rapidly growing, and increasingly decentralized, metropolitan area. Population has decentralized since 1970, as shown in Figure 65. This figure provides maps of population by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of population from Miami-Dade County to the other two counties in the MSA.

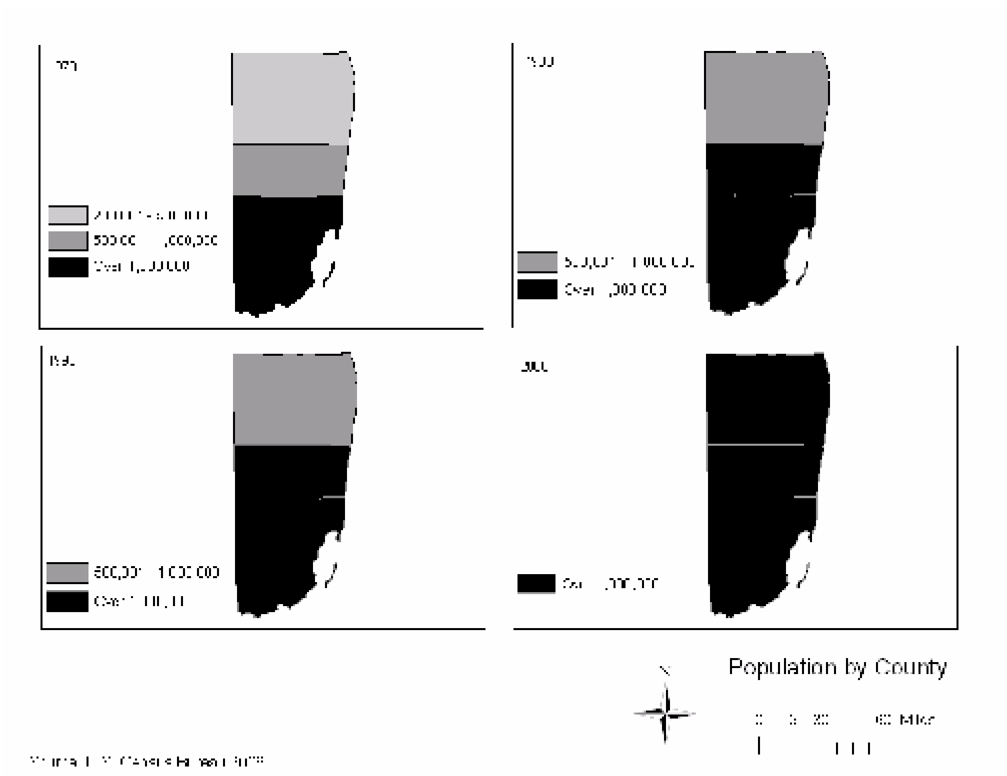


Figure 65 Miami MSA: population by county (1970–2000)

Between 1970 and 2005, total MSA population increased 142% from approximately 2.2 million to just over 5.4 million persons (see Table 64). All three counties have grown significantly since 1970, although population growth in Miami-Dade County (87%) is below that in Broward (187%) and Palm Beach Counties (263%). The result is that while Miami-Dade County accounted for 57% of MSA population in 1970, it accounted for only 44% in 2005.

The authors also obtained detailed population data for Miami-Dade County for 2005. (The other two counties represent separate MPOs. They were not able to obtain these detailed data for these two counties.) Figure 66 shows population density by transportation analysis zone (TAZ) for Miami-Dade County in 2005. Population density is expressed as persons per acre. The figure shows that population is dispersed throughout the county, but that several large population clusters exist. These clusters include the barrier islands to the east (including Miami Beach), a corridor running northwest from the Miami CBD, and pockets throughout the northern and central portions of the county. The map also shows pockets of high population densities near the edges of the populated area, a pattern that is not observed in most of the other study cities. The western and southern portions of Miami-Dade County are sparsely populated, although these areas have seen significant development in recent years.

Distribution of MSA Employment

Employment has also increased and decentralized since 1970 (see Figure 67). This figure provides maps of employment by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of employment from Miami-Dade County first to Broward County then to Palm Beach County.

Total MSA employment has increased steadily since 1970. Between 1970 and 2005, total MSA employment increased 198% from 1.1 million to 3.1 million jobs (see Table 65). Employment growth in Miami-Dade County has been slower (113%) than employment growth in Broward (305%) and Palm Beach Counties (379%). The Miami CBD has experienced sizeable employment growth between 1970 and 2005 (422%), and its growth rate exceeds the growth rate for suburban employment in Miami-Dade County (103%). Much of the Miami CBD's employment growth occurred prior to 1990.

The authors obtained detailed employment data for 2005 in Miami-Dade County. Figure 68 maps employment density by TAZ. Density is measured as the number of jobs per acre. The figure shows that employment is very dispersed inside Miami-Dade County. The Miami CBD emerges as an employment center, as does the Miami International Airport west of the CBD, Miami Beach to the east, and two corridors radiating northwest and southwest of the Miami CBD.

Population and employment inside Miami-Dade County are decentralized, although employment tends to cluster in places like the Miami CBD, Miami International Airport, Miami Beach, and in corridors that appear to correspond to major roadways (see Figure 66 and Figure 68). The pattern of activities described by these maps suggests the necessity of a decentralized transit system, but one which provides good service to the major activity centers. The authors discuss the Miami-Dade transit system later in the case study.

Table 64 Population in the Miami metro area (1970–2005)

Year	Miami-Dade County	Broward County	Palm Beach County	Total MSA (3 counties)
1970	1,267,792	620,100	348,993	2,236,885
1971	1,325,000	668,200	371,500	2,364,700
1972	1,377,400	709,600	391,800	2,478,800
1973	1,409,500	767,200	427,900	2,604,600
1974	1,448,700	840,600	456,700	2,746,000
1975	1,493,300	869,200	475,000	2,837,500
1976	1,511,600	884,700	487,800	2,884,100
1977	1,530,800	907,000	499,800	2,937,600
1978	1,542,000	942,600	518,300	3,002,900
1979	1,584,600	986,400	550,900	3,121,900
1980	1,625,509	1,018,257	576,754	3,220,520
1981	1,710,380	1,055,347	620,590	3,386,317
1982	1,727,093	1,076,762	645,890	3,449,745
1983	1,744,006	1,095,086	667,449	3,506,541
1984	1,755,583	1,110,862	693,847	3,560,292
1985	1,776,908	1,132,921	723,005	3,632,834
1986	1,801,410	1,154,494	753,379	3,709,283
1987	1,831,362	1,180,921	784,835	3,797,118
1988	1,868,311	1,208,428	815,019	3,891,758
1989	1,908,921	1,233,040	842,086	3,984,047
1990	1,943,717	1,263,301	871,560	4,078,578
1991	1,981,618	1,296,261	898,852	4,176,731
1992	2,011,174	1,325,375	926,446	4,262,995
1993	2,010,635	1,372,526	957,014	4,340,175
1994	2,044,512	1,412,641	988,009	4,445,162
1995	2,086,286	1,447,124	1,013,781	4,547,191
1996	2,130,937	1,481,333	1,040,144	4,652,414
1997	2,158,352	1,522,179	1,069,718	4,750,249
1998	2,180,081	1,560,649	1,096,123	4,836,853
1999	2,220,961	1,594,130	1,116,913	4,932,004
2000	2,253,362	1,623,018	1,131,184	5,007,564
2001	2,286,731	1,670,494	1,158,587	5,115,812
2002	2,314,547	1,703,998	1,187,243	5,205,788
2003	2,335,739	1,728,336	1,212,269	5,276,344
2004	2,358,714	1,753,000	1,244,189	5,355,903
2005	2,376,014	1,777,638	1,268,548	5,422,200

Source: U.S. Census Bureau, 2007.

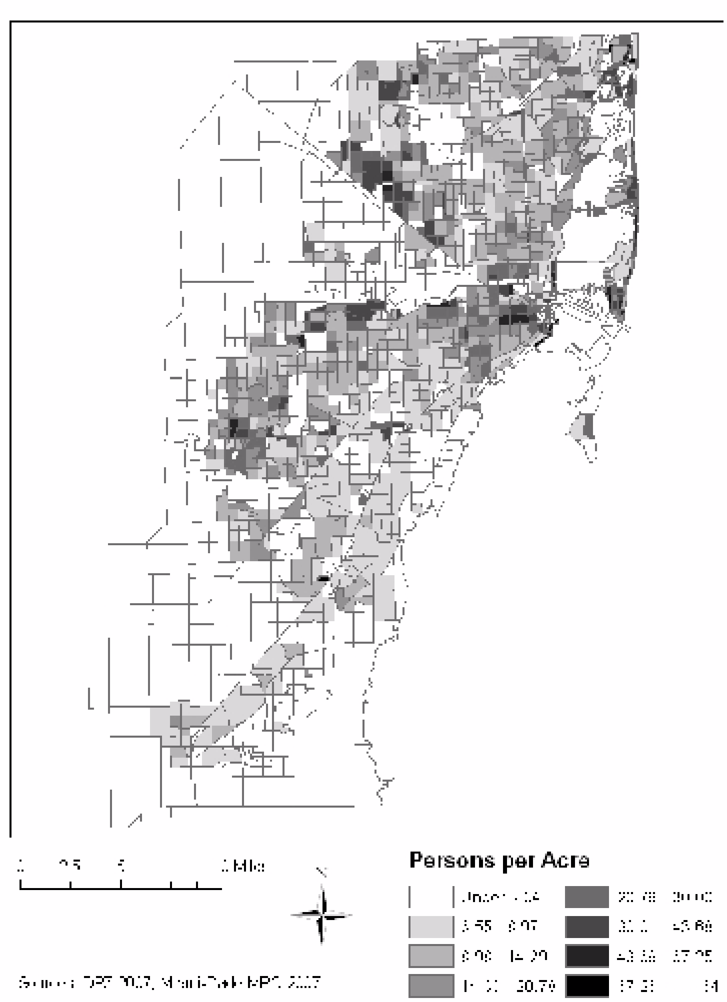


Figure 66 Miami-Dade County: population density by transportation analysis zone (2005)

Institutions and Key Actors

A number of public-sector entities play a role in transit policy in the Miami MSA. Each of the three counties has its own transit agency and its own MPO. At the regional scale, the South Florida Regional Transportation Authority (SFRTA) operates Tri-Rail commuter rail service, and could potentially become the venue for regional transit planning and service coordination. The authors introduce the key actors for all three counties here, although the primary focus in the remainder of the case study is Miami-Dade County.

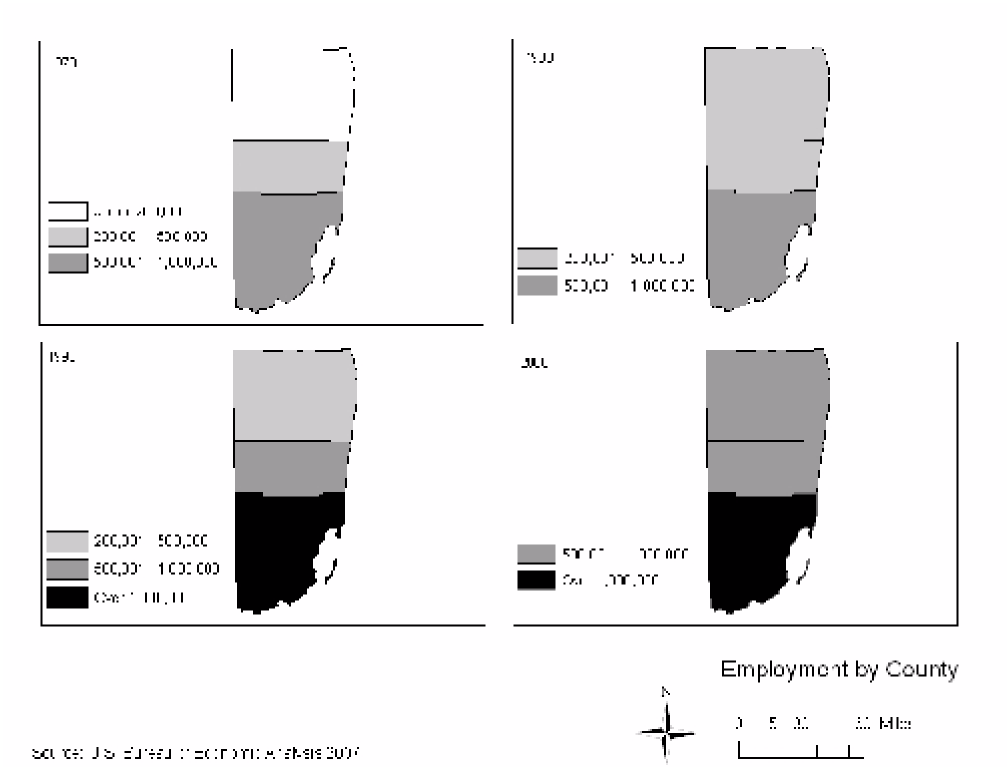


Figure 67 Miami MSA: employment by county (1970–2000)

Table 65 Employment in the Miami metropolitan area (1970–2005)

Year	Miami-Dade County			Broward County	Palm Beach County	Total MSA (3 counties)
	Miami CBD	Outside Miami CBD	Total			
1970	20,926	626,420	647,346	246,603	160,144	1,054,093
1971	21,031	644,257	665,288	257,958	164,770	1,088,016
1972	21,136	692,248	713,384	286,969	178,148	1,178,501
1973	21,241	752,963	774,204	330,419	199,436	1,304,059
1974	21,348	757,502	778,850	345,633	206,053	1,330,536
1975	21,454	719,565	741,019	329,529	204,973	1,275,521
1976	21,562	727,713	749,275	332,619	210,738	1,292,632
1977	21,669	755,831	777,500	361,545	228,583	1,367,628
1978	21,778	804,384	826,162	403,446	254,285	1,483,893
1979	21,887	838,468	860,355	431,156	276,930	1,568,441
1980	22,000	887,907	909,907	460,403	295,818	1,666,128
1981	25,106	905,158	930,264	478,636	312,529	1,721,429
1982	28,651	893,629	922,280	480,729	322,909	1,725,918
1983	32,697	904,162	936,859	497,562	342,832	1,777,253
1984	37,314	931,443	968,757	531,457	371,451	1,871,665
1985	42,583	945,350	987,933	554,293	391,939	1,934,165
1986	48,595	954,006	1,002,601	573,811	413,569	1,989,981

Table 65 Employment in the Miami metropolitan area (1970–2005)

Year	Miami-Dade County			Broward County	Palm Beach County	Total MSA (3 counties)
	Miami CBD	Outside Miami CBD	Total			
1987	55,457	946,720	1,002,177	574,249	423,625	2,000,051
1988	63,287	980,985	1,044,272	600,572	450,306	2,095,150
1989	72,224	990,508	1,062,732	619,242	461,950	2,143,924
1990	82,428	990,368	1,072,796	632,471	466,318	2,171,585
1991	83,986	971,240	1,055,226	626,216	466,476	2,147,918
1992	85,573	963,954	1,049,527	636,219	466,548	2,152,294
1993	87,191	996,821	1,084,012	669,973	486,012	2,239,997
1994	88,838	1,011,703	1,100,541	705,259	502,550	2,308,350
1995	90,518	1,035,040	1,125,558	742,292	519,251	2,387,101
1996	92,228	1,060,079	1,152,307	747,995	544,698	2,445,000
1997	93,971	1,084,286	1,178,257	768,996	568,611	2,515,864
1998	95,747	1,109,162	1,204,909	797,335	593,923	2,596,167
1999	97,557	1,149,453	1,247,010	825,937	619,644	2,692,591
2000	99,440	1,176,563	1,276,003	848,098	649,633	2,773,734
2001	101,319	1,210,912	1,312,231	885,798	677,985	2,876,014
2002	103,234	1,210,067	1,313,301	902,257	691,453	2,907,011
2003	105,185	1,215,939	1,321,124	927,127	708,623	2,956,874
2004	107,173	1,237,443	1,344,616	944,944	727,186	3,016,746
2005	109,199	1,271,457	1,380,656	997,916	767,187	3,145,759

Source: U.S. Bureau of Economic Analysis, 2007; U.S. Census Bureau 1970, 1980, 1990, 2000.

Broward County Metropolitan Planning Organization

The Broward County Metropolitan Planning Organization is the MPO for Broward County. The Broward County MPO approves the Transportation Improvement Program (TIP) and Long Range Transportation Plan (LRTP) required by federal and state legislation. The Broward County MPO operates only in Broward County. The MPO is divided into five districts. The appointed 19-member board includes representatives of cities (appointed to reflect the MPO districts), Broward County School Board, Broward County Board of Commissioners, and South Florida Regional Transportation Authority.

Broward County Transit

Broward County Transit (BCT) is the public transit agency in Broward County. BCT operates fixed-route bus service and demand-responsive service. BCT is part of the county government. BCT route 18 provides service between Broward County and portions of Palm Beach and Miami-Dade Counties.

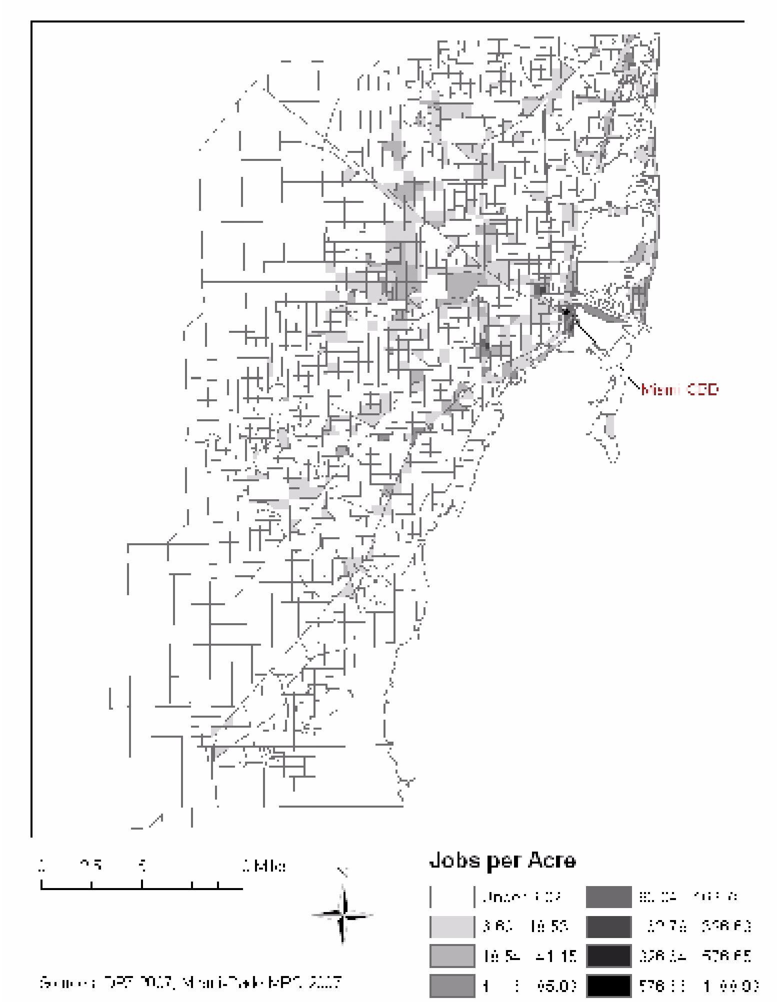


Figure 68 Miami-Dade County: employment density by transportation analysis zone (2005)

Miami-Dade Metropolitan Planning Organization

The Miami-Dade Metropolitan Planning Organization is the MPO for Miami-Dade County. The Miami-Dade MPO approves the Transportation Improvement Program (TIP) and Long Range Transportation Plan (LRTP) required by federal and state legislation. The Miami-Dade MPO operates only in Miami-Dade County. The appointed board includes 13 county commissioners, five elected officials from each of the cities with populations over 50,000, one representative from the unincorporated areas, one representative from the Miami-Dade Expressway Authority, one member of the Miami-Dade School Board, and two non-voting representatives appointed by the Florida Department of Transportation.

Miami-Dade Transit

Miami-Dade Transit (MDT) is the transit operator in Miami-Dade County. MDT operates fixed-route and demand-responsive bus service, Metro Mover, and Metro Rail. MDT is part of the Miami-Dade County government.

Palm Beach Metropolitan Planning Organization

The Palm Beach Metropolitan Planning Organization is the MPO for Palm Beach County. The Palm Beach MPO approves the Transportation Improvement Program (TIP) and Long Range Transportation Plan (LRTP) required by federal and state legislation. The Palm Beach MPO operates only in Palm Beach County. The appointed 17-member board includes five county commissioners and 12 representatives who are elected officials from the cities in the county.

Palm Tran

Palm Tran is the transit agency in Palm Beach County. Palm Tran operates both fixed-route and demand-responsive bus service. Palm Tran service is largely limited to Palm Beach County. Palm Tran is a unit of the county government.

South Florida Regional Transportation Authority

Created in 2003, South Florida Regional Transportation Authority (SFRTA) is supposed to define a regional mobility vision and coordinate and implement the service needed to make this vision a reality. The SFRTA has a nine-member board that includes three county commissioners. SFRTA has bonding authority, but no taxation authority. It is dependent on the three counties for its annual funding. At the present, SFRTA operates the Tri-Rail commuter rail service. One of the interviewees sees some potential for Tri-Rail to be the backbone of a regional transit system.

Transit Agencies, Modes, Fares, and Rider Profiles

Four transit agencies provide service in the Miami MSA (see Figure 69). Three agencies combined account for half the MSA total transit ridership: Broward County Transit, Palm Beach Transit, and Tri-Rail. Miami-Dade Transit accounts for the other half of MSA total transit ridership, and is thus the primary transit agency.

Smaller Agencies

Broward County Transit (BCT) operates 43 bus routes in Broward County (see Figure 70). Nearly half the routes intersect with the Tri-Rail commuter rail line, but there is no practical integration of the two transit services. Little transfer activity occurs between them. Tri-Rail relies on its own bus service to connect patrons to destinations. BCT routes do not serve the Miami CBD, but routes do intersect with Miami-Dade Transit service that allows riders to reach the Miami CBD and other destinations inside Miami-Dade County. A couple routes also connect to Palmtran.

As of October 1, 2007, BCT's base fare was $1.25.[154] BCT offers reduced fares for youths, senior citizens, the disabled, and individuals who purchase multi-ride passes, day passes, monthly passes, or student passes from local colleges or universities.

BCT recently unveiled a new transfer policy. When BCT riders wish to transfer to Miami-Dade Transit, Tri-Rail, or Palm Beach Transit service, they receive a free transfer from BCT but pay the regular fare on the other system; thus they ride the BCT service for free. When riders on other systems wish to transfer to BCT, they pay 50 cents to do so.

BCT has experienced significant service and ridership growth since 1984 (see Table 66). During this time, average bus trip lengths remained fairly stable; load factor (the ratio of passenger miles to vehicle miles), a measure of service productivity, declined from 1984 to the mid-1990s and then stabilized thereafter. Service productivity stabilized at about the time BCT restructured its service by moving bus routes out of neighborhoods and onto arterial roads in order to provide more direct routes and more frequent service. One of the study's interviewees observed that the restructuring was "wildly successful" in terms of its effects on ridership and service productivity. More recently, BCT restored neighborhood service under the guise of community bus service. One of the interviewees characterized community bus service as very poor performing. One community has decided to cancel its community bus service because of its poor performance.

BCT's strong performance is particularly striking compared to second-ranked operators in other metropolitan areas, such as The T that serves Fort Worth, Texas in the Dallas-Fort Worth MSA. The T concentrates its service on a traditional CBD using a radial network. In contrast, BCT features a decentralized grid that serves many important destinations. BCT enjoys much higher ridership and better service productivity than The T, and is enjoying ridership and productivity increases in recent years where The T has experienced declining ridership and productivity.

Palm Beach Transit (Palm Tran) operates 35 bus routes in Palm Beach County (see Figure 71). Nearly all the routes provide service that is limited to Palm Beach County destinations. Nearly half the routes have stops at Tri-Rail stations. These connections and a few links to BCT routes are the mechanisms for serving inter-county trips with origins or destinations in Palm Beach County. Palm Tran's performance statistics are reported in Table 67.

As of October 1, 2007, Palm Tran's one-way base cash fare is $1.50.[155] Palm Tran offers reduced fares for senior citizens, students, the disabled, and individuals who purchase daily or monthly passes. Palm Tran patrons who wish to transfer to BCT service pay BCT 50 cents. Tri-Rail patrons enjoy a free transfer to Palm Tran bus at the Tri-Rail station but pay 50 cents for other kinds of transfers.

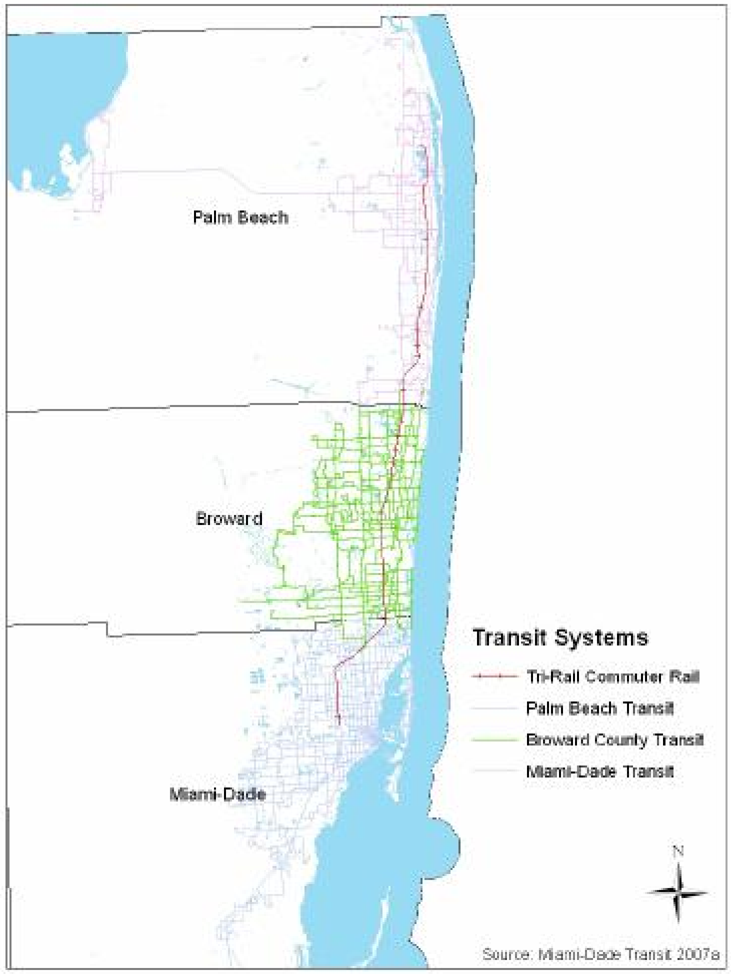


Figure 69 Transit system in the Miami metropolitan area (2007)

Tri-Rail operates commuter rail service between Palm Beach County and Miami-Dade County (see Figure 69). All other transit agencies in the metropolitan area connect to Tri-Rail stations. Tri-Rail recently completed a double-tracking program that allows it to operate more frequent service. They now run approximately 50 trains per day. Peak-period headways range between 20 and 30 minutes, while off-peak service is hourly.

Tri-Rail uses a zone-based fare system.[156] There are six fare zones. One-way fares range from $2.00 to $5.50. Tri-Rail discounts its fare for senior citizens, children, the disabled, and individuals who purchase round-trip rides, multi-trip rides, and monthly passes. Transfers between Tri-Rail and either BCT or Palm Tran are handled in the manner discussed above. Miami-Dade Transit patrons wishing to transfer to Tri-Rail pay for a 50 cent (or 25 cent) transfer that entitles them to a $1.75 (or 75 cent) discount on their Tri-Rail fare. Tri-Rail patrons enjoy free transfers to all Miami-Dade Transit services except express buses. According to one of the interviewees, Tri-Rail patronage represents a very small share of ridership on the various agencies' routes so they tend not to focus much of their service on Tri-Rail stations.[157]

Figure 70 Transit system in Broward County (2007)

Table 66 Broward County Transit (BCT) ridership, service and performance (1984–2004)

Year	Passenger Miles	Passenger Trips	Vehicle Miles	Average Trip Length (miles)	Load Factor
1984	72,755,935	13,288,100	7,573,327	5.48	9.61
1985	84,264,996	17,301,434	8,192,688	4.87	10.29
1986	78,991,384	17,757,493	9,102,934	4.45	8.68
1987	61,379,078	12,145,868	9,584,237	5.05	6.40
1988	75,028,484	13,797,654	9,618,706	5.44	7.80
1989	67,589,568	14,413,249	9,682,571	4.69	6.98
1990	81,992,838	17,049,804	9,764,756	4.81	8.40
1991	81,118,030	19,537,266	9,865,373	4.15	8.22
1992	97,622,366	20,551,805	9,890,909	4.75	9.87
1993	96,753,748	21,726,113	9,915,522	4.45	9.76
1994	103,822,086	22,789,308	10,538,267	4.56	9.85
1995	111,004,429	23,967,275	10,554,963	4.63	10.52
1996	109,542,370	24,220,674	10,595,490	4.52	10.34
1997	110,289,977	25,638,291	10,575,799	4.30	10.43
1998	111,568,312	25,847,114	11,362,098	4.32	9.82
1999	114,736,758	26,469,628	11,548,953	4.33	9.93
2000	119,986,652	27,573,149	13,001,595	4.35	9.23
2001	137,200,475	31,520,462	14,356,714	4.35	9.56

Table 66 Broward County Transit (BCT) ridership, service and performance (1984–2004)

Year	Passenger Miles	Passenger Trips	Vehicle Miles	Average Trip Length (miles)	Load Factor
2002	142,999,966	32,813,786	15,943,848	4.36	8.97
2003	153,883,282	35,912,736	16,714,484	4.28	9.21
2004	162,009,619	38,256,615	16,687,046	4.23	9.71

Source: Florida Department of Transportation, 2006.

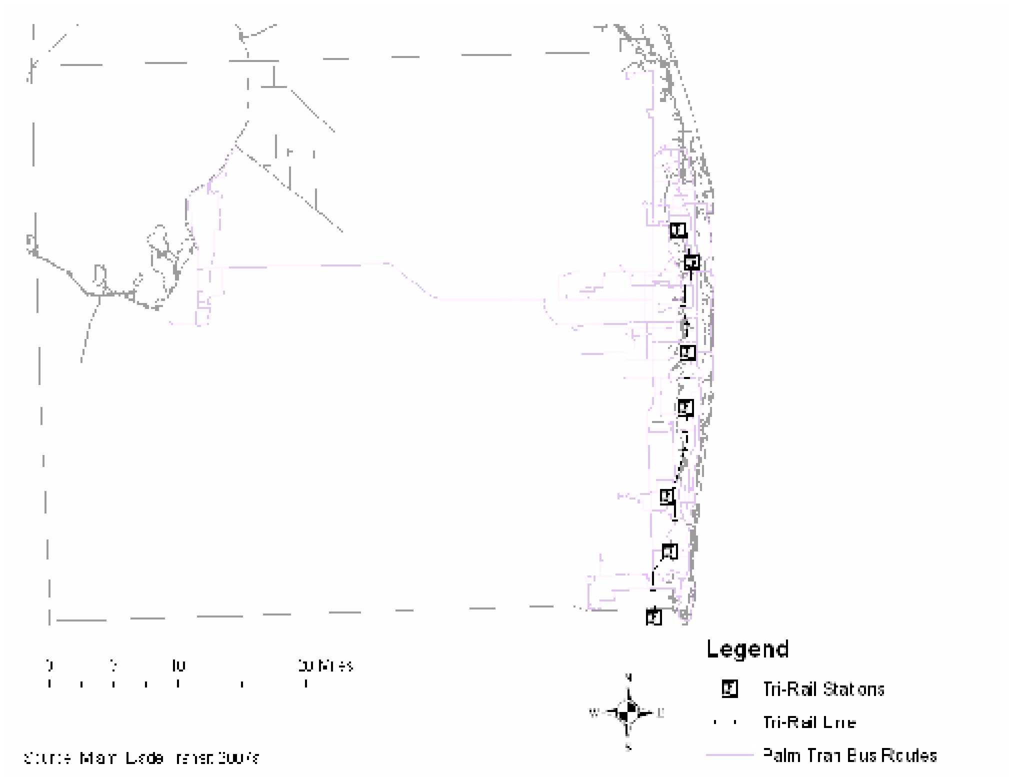


Figure 71 Transit system in Palm Beach County (2007)

Table 68 reports Tri-Rail ridership, service, and productivity data from the system's creation in 1989 to 2004. The table indicates ridership and service growth and stable service productivity, particularly in the past several years. According to one of the interviewees, Tri-Rail ridership has expanded on the order of 10–15% per month since the double tracking program was completed and service frequency increased.

Table 67 Palm Tran ridership, service and performance (1984–2004)

Year	Passenger Miles	Passenger Trips	Vehicle Miles	Average Trip Length (miles)	Load Factor
1984	7,274,055	2,233,615	2,450,895	3.26	2.97
1985	7,963,396	2,331,523	2,538,688	3.42	3.14
1986	15,364,329	2,427,072	2,548,170	6.33	6.03
1987	16,332,865	2,432,638	2,556,022	6.71	6.39
1988	13,840,034	2,274,722	2,480,598	6.08	5.58
1989	13,625,359	2,148,078	2,728,980	6.34	4.99
1990	16,012,742	2,386,625	3,216,353	6.71	4.98
1991	17,190,100	2,712,882	3,147,476	6.34	5.46
1992	17,190,100	2,712,882	3,170,818	6.34	5.42
1993	17,380,373	2,714,615	3,290,462	6.40	5.28
1994	17,380,373	2,714,615	3,322,479	6.40	5.23
1995	17,380,373	2,714,615	3,459,374	6.40	5.02
1996	15,867,178	2,746,242	5,527,342	5.78	2.87
1997	19,334,310	3,971,573	8,443,867	4.87	2.29
1998	23,841,739	4,431,208	7,671,447	5.38	3.11
1999	38,063,930	5,782,238	7,677,566	6.58	4.96
2000	42,622,740	6,463,416	7,760,605	6.59	5.49
2001	34,922,119	5,925,335	6,678,611	5.89	5.23
2002	38,938,245	6,398,672	7,122,874	6.09	5.47
2003	45,199,283	7,199,527	7,235,019	6.28	6.25
2004	47,040,815	7,654,292	7,546,510	6.15	6.23

Source: Florida Department of Transportation, 2006.

Table 68 Tri-Rail ridership, service and performance (1989–2004)

Year	Passenger Miles	Passenger Trips	Vehicle Miles	Average Trip Length (miles)	Load Factor
1989	9,240,024	291,367	510,900	31.71	18.09
1990	32,131,966	1,082,189	1,208,888	29.69	26.58
1991	64,469,462	1,870,671	1,704,616	34.46	37.82
1992	76,801,512	2,266,473	1,892,300	33.89	40.59
1993	88,615,547	2,697,456	2,382,333	32.85	37.20
1994	96,504,139	2,912,895	2,543,840	33.13	37.94
1995	87,010,060	2,735,415	2,501,381	31.81	34.78
1996	70,403,237	2,305,492	2,530,008	30.54	27.83
1997	69,462,568	2,315,394	2,549,189	30.00	27.25
1998	68,109,165	2,348,592	2,363,927	29.00	28.81
1999	64,504,376	2,171,142	1,846,724	29.71	34.93
2000	67,099,046	2,232,497	1,872,082	30.06	35.84

Table 68 Tri-Rail ridership, service and performance (1989–2004)

Year	Passenger Miles	Passenger Trips	Vehicle Miles	Average Trip Length (miles)	Load Factor
2001	77,380,434	2,543,514	2,090,197	30.42	37.02
2002	76,014,890	2,530,321	2,063,618	30.04	36.84
2003	81,879,635	2,725,142	2,158,272	30.05	37.94
2004	84,761,980	2,821,329	2,141,998	30.04	39.57

Source: Florida Department of Transportation, 2006.

Miami-Dade Transit Service and Modes

The Miami MSA's largest transit operator is Miami-Dade Transit, which accounts for about half the total MSA transit ridership. Miami-Dade Transit (MDT) operates 119 bus routes, three automated guideway loops, and one heavy rail system in Miami-Dade County (see Figure 72). The rail services are confined to the center and northern parts of the county. The rail lines date back to the mid-1980s (see Table 69). Miami-Dade Transit also has a busway along U.S. 1 that extends the reach of the heavy rail Metro Rail system into the southern suburbs.

The three automated guideway loops operate as Metromover and serve the Miami CBD (see Figure 73). The heavy rail system operates as Metrorail and runs in a north-south direction between Palmetto and Dadeland South via the Miami CBD. Of MDT's 119 bus routes, 43 serve the Miami CBD while 90 serve either MDT heavy rail or Tri-Rail commuter rail stations.

Table 69 Miami MDT rail segment openings since 1984

Year	Segment Length (miles)	Line	Section	Cumulative System Length
Metro Rail				
1984	9.5	Metrorail	Dadeland South—Overtown/Arena	9.5
1984	3.9	Metrorail	Overtown/Arena—Earlington Heights	13.4
1985	7.1	Metrorail	Earlington Heights—Okeechobee	20.5
2002	1.4	Metrorail	Okeechobee—Palmetto	21.9
Metro Mover				
1986	1.9	Metromover Downtown Loop	Government Center—Bayfront Park—Government Center	1.9
1994	0.9	Omni Loop	Downtown Loop—School Board	2.8
1994	1.6	Brickell Loop	Downtown Loop—Financial District	4.4

Source: Leroy Demery, *U.S. Urban Rail Transit Lines Opened from 1980*, October 18, 2005, 16,17.

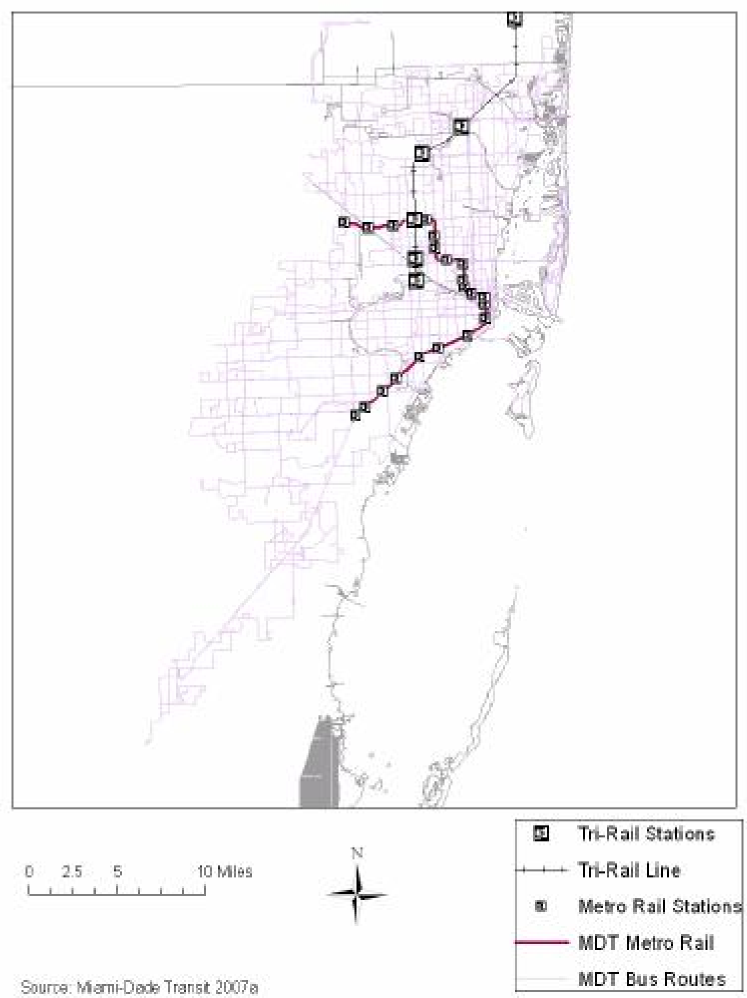


Figure 72 Transit system in Miami-Dade County (2007)

Miami-Dade Transit Rider Profile

In October 2004, the University of South Florida's Center for Urban Transportation Research (CUTR) and Behavior Science Research Corporation (BSR) conducted on-board surveys of Miami-Dade Transit bus and rail riders.[159] Using these surveys of 27,000 bus patrons and 9,000 rail patrons, the authors developed rider profiles for patrons of both types of services.

Table 70 presents the rider profile for bus patrons, while Table 71 presents the rider profile for rail patrons. The tables show that bus and rail have identical proportions of male and female riders. The tables also indicate the bus patrons are more likely to be members of transit dependent groups than are rail patrons. Both motor vehicle ownership and household income tend to be slightly lower for bus patrons than for rail patrons. Forty-five percent of bus patrons reported having no vehicles in their household, as opposed to less than one quarter of rail patrons. More than 80% of bus patrons reported household incomes under $30,000, as opposed to 66% of rail patrons.

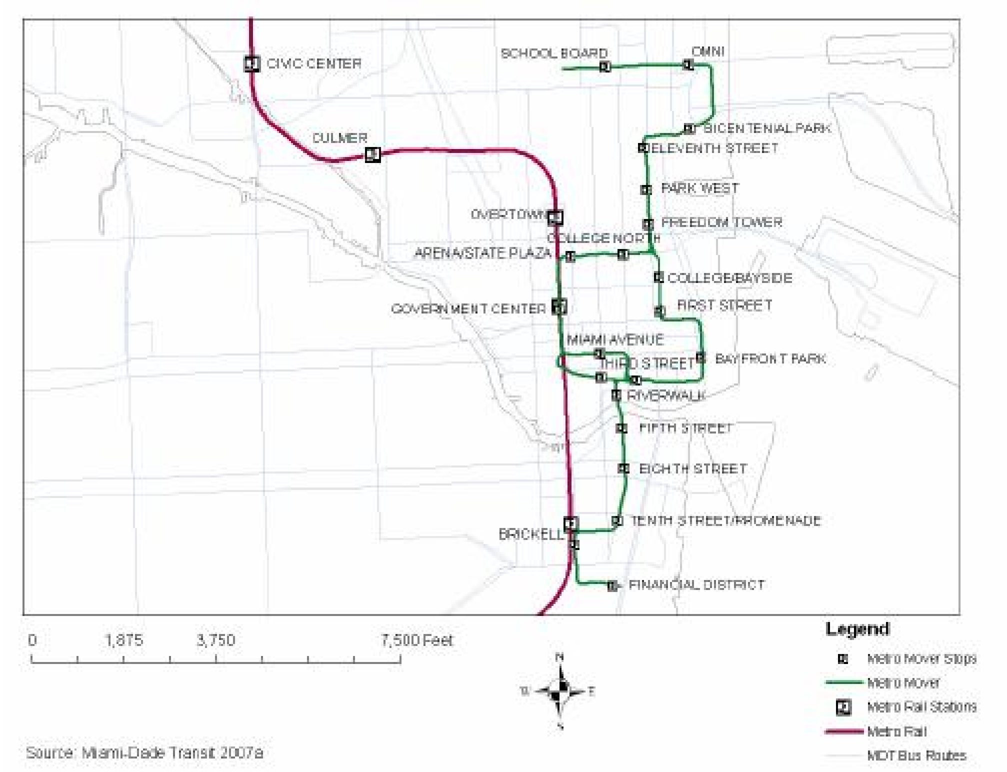


Figure 73 Rail transit in the Miami central business district (2007)

Table 70 Demographics of MDT bus riders

Survey Category	Response	Percent Total
Gender	Male	47
	Female	53
Household Vehicles	None	45
	One	34
	Two	16
	Three or more	6
Income	Under $10,000	40
	$10,000 to $15,000	18
	$15,001 to $20,000	13
	$20,001 to $30,000	13
	$30,001 to $40,000	7
	$40,001 to $60,000	5
	$60,001 to $80,000	2
	$80,001 or more	2

Source: Petra Brock and Robert Ladner, *Summary of Ridership Patterns of Metrobus Riders in Miami-Dade County*, Miami-Dade Transit, June 2005, 3–4.

Table 71 Demographics of MDT metro rail riders

Survey Category	Response	Percent Total
Gender	Male	47
	Female	53
Household Vehicles	None	24
	One	31
	Two	28
	Three	11
	Four or more	6
Income	Under $10,000	28
	$10,000 to $15,000	15
	$15,001 to $20,000	10
	$20,001 to $30,000	13
	$30,001 to $40,000	9
	$40,001 to $60,000	11
	$60,001 to $80,000	6
	$80,001 or move	8

Source: Petra Brock and Robert Ladner, *Summary of Ridership Patterns of Metrorail Riders in Miami-Dade County*, Miami-Dade Transit, June 2005, p. 3–4.

Regional Transit Vision and Its Evolution

The study's interviewees provided an overview of the regional transit vision and its evolution, both at a metropolitan area-wide scale and at a more localized scale inside Miami-Dade County.[160] The more regional vision has emerged in the past several years, particularly since the creation of the South Florida Regional Transportation Authority (SFRTA) in 2003.

According to one of the interviewees, the impetus for creation of SFRTA came from a 2002 regional transit summit at which the metropolitan planning organizations, transit agencies, and seaports collaborated to develop a list of regional projects. This summit did not create a plan, but it did lead to the Florida Legislature's creation of SFRTA, which would be the entity taking the lead in the development of the regional plan. Tri-Rail had actually developed a master plan of transit improvements for the region, but this plan fell to the wayside when SFRTA was created. Since SFRTA's creation, it has been working to define key regional corridors and potential transit improvements for these corridors. A major challenge is coordinating service across the three counties. Presently, buses tend to turn around at county boundaries. Transfers occur between the agencies, but these are largely forced by the jurisdictional boundaries.

There is clearly need for a more regional approach to transit service delivery, and two of the interviewees noted that SFRTA might become the basis for a regional transit agency. However, the interviewees felt that this was likely to occur over a 20-to-30 year time horizon. At present, the regional transit system consists of Tri-Rail and high-occupancy toll lanes in development on I-95 between Broward and Miami-Dade Counties. The interviewees see more regional projects coming, with regional express buses a potential near-term development. A major initiative already in the works is the development of the Florida East Coast (FEC) Railroad corridor that runs parallel to Tri-Rail. The region is planning to develop this corridor as light rail transit with stops every ½ mile running between Fort Lauderdale and Miami. At the northern end of the region, they are looking to extend Tri-Rail commuter service from West Palm Beach to Jupiter. One interviewee observed that what is lacking in current rail plans are east-west routes. Broward County proposed a package of transit improvements that included an east-west LRT line, but this package was defeated in November 2006. Broward County officials have begun to consider bus rapid transit as an alternative to light rail transit.

In summary, the metropolitan area-wide transit vision is still in development but features a heavy reliance on rail transit service to function as a framework for regional transit. Tri-Rail could become the cornerstone of the regional network, but right now there is modest interaction between Tri-Rail and the three local operators in the three counties. The need for better coordination among the various transit agencies is critical. SFRTA was created to play a leadership role, and might one day form the basis for a truly regional transit agency, but it is still early in the plan development process to make a judgment about its performance to date.

At the more localized scale of Miami-Dade County, a regional transit vision dates back to the 1970s. The cornerstone of this vision has been the development of rapid transit. The first major rapid transit initiative was the Decade of Progress plan in 1972. This plan called for major infrastructure improvements, including the development of a 54-mile elevated rail rapid transit system, a system of trunk-line bus routes on expressways and major arterials, and circulator systems at major activity centers. Voters approved the bonds to implement this plan in November 1972.

According to the interviewees, the objective of rail development was to improve mobility and stimulate development around rail stations. Rail transit development was seen as a substitute for highway development; indeed, the Decade of Progress plan emerged from an anti-highway backlash in the late 1960s. The ambitious plan immediately ran into trouble when residents of Miami Beach opposed the development of elevated rail in their community. This essentially removed the highest ridership corridor from the plan. Other community objections and local political considerations also affected the alignment. Community objections in Coral Gables led to only the station at the University of Miami being provided. The political establishment's desire to appeal to Latino voters led to the line being run through Hialeah instead of along the preferred 27th Avenue corridor. According to the interviewees, the Hialeah alignment decision had a significant negative effect on the system's ultimate ridership.

In the Miami CBD, the availability of FEC right of way, the high water table, and the lack of right of way on downtown streets for potential elevated rail construction led to an alignment on the western edge of downtown. Metro Mover, the area's automated guideway system, was then developed to distribute people downtown.

The interviewees stated that the bus system was subordinate to rail in the Miami-Dade County transit vision. In 1975, the Metro Transit Agency consolidated the prior private and municipal transit systems. The bus system was a CBD-radial system characterized by what one of the interviewees characterized as insufficient service frequency. Essentially, the Board of County Commissioners decided to provide every developed area of the county with ¼ mile (or less) distance access to transit, but did not have the resources to provide frequent service over the extensive network. Very little bus restructuring occurred prior to the opening of the first Metro Rail segment in 1984.

Following the opening of the Metro Rail, the transit agency embarked on a major bus service restructuring that called for the truncating of downtown-bound bus routes at Metro Rail stations. The restructuring effort, called Network 86, affected the entire transit system, and prompted a major public backlash, particularly in the African American community. The agency responded by adding bus service back in many areas. However, one of the interviewees noted that many of the changes implemented at this time are still in place. The result is that the bus system is more of a grid and is better aligned with the arterial roads than it was prior to restructuring. Subsequent efforts to restructure bus routes in order to achieve operating cost savings and other service efficiencies have been done on a route-by-route basis. According to the interviewees, studies proposing major service restructuring as part of the recent Metro Mover extension led to little significant change in bus service.

In recent years, Miami developed a busway to extend the reach of the Metro Rail line to the southern part of the county. Originally, the plan called for Metro Rail's extension, but insufficient money led to the lower-cost busway. The study's interviewees report that the busway is carrying riders, but that ridership is limited by parking capacity at park-and-ride lots and the infrequent service being run on buses that feed the busway.

Miami-Dade County's current transit vision is articulated in the People's Transportation Plan (PTP) approved by voters in November 2002. PTP included a ½ cent sales tax whose proceeds are to be used to build an additional 89 miles of rail rapid transit, nearly double the size of the bus fleet from 700 to 1,191 vehicles, and fund other capital improvements over a 30 year period. Given the transit system's financial history, the challenging part will be to come up with the money required to operate this ambitious system once its pieces are in place. The PTP also created a citizen's watchdog group, the Citizens Independent Transportation Trust (CITT), to make sure the money raised from the sales tax is used for its intended purposes.

Regional Transit System Structure and Function

In Miami-Dade County, the transit system resembles a bus grid with a rail radial overlay (see Figure 72). Bus restructuring, particularly in the mid 1980s, has led to a closer relationship between bus and rail that is reflected in relatively high transfer rates across the modes. MDT's mix of modes include fixed-route buses, shuttle buses that feed rail stations, heavy rail, and automated guideway transit. The sense of the interviewees is that these modes relate to one another fairly well, and that all the modes are carrying good ridership despite the lack of resources to provide higher frequency service.

Metro Rail ridership has been a target of many rail critics. These critics point to the forecast of 200,000 passengers per day used when the plan was presented to the public versus the actual 45,000 to 50,000 passengers per day on the current system. The study's interviewees emphasized that the forecast figure was for a more extensive system than was actually built, and that the actual ridership numbers correspond pretty well with the forecasted numbers for the two segments that were built. The authors' contacts also emphasized that limited parking garage capacity and infrequent bus service connecting people to the stations are the major barriers to higher ridership on the rail system.

Transfers

One of the interviewees observed that about 40% of MDT bus passengers require a transfer to complete their trip. This same contact advised us that monthly pass holders who transfer are counted as pass boardings (and not as transfers), so the transfer data underreport transfer activity. The authors obtained summaries from the 2004 on-board surveys that provide information about transfer activity on both MDT's bus and rail systems.[161] Table 72 reports access and egress methods for Miami-Dade Transit bus riders. In order to calculate the percent of bus riders who transfer, they add the percent accessing MDT buses by transferring from other transit services (19%) to the percent that depart buses (egress) and transfer to another transit mode (25%). The summation yields a 45% transfer rate for MDT bus patrons.

Table 72 Access/egress methods for MDT bus riders

Method	Access Percent	Egress Percent
Walked 0–3 blocks	58	54
Walked more than 3 blocks	16	16
Was passenger in car	5	3
Rode bicycle	1	1
Dove my car	1	1
Transferred from Metrorail	7	8
Transferred from Metromover	1	1
Transferred from Tri-Rail	1	1
Transferred from Metrobus	10	15
Other	2	2

Source: Petra Brock and Robert Ladner, *Summary of Ridership Patterns of Metrobus Riders in Miami-Dade County*, Miami-Dade Transit, June 2005, 9–10.

Table 73 presents the same type of data for Miami-Dade Transit rail patrons. The most common mode of accessing Metrorail services was through a Metrobus transfer, with more than a quarter of the respondents using this method; more than a quarter of Metrorail riders transferred to Metrobus service to complete their trip. A small number of passengers either transferred to or from Metromover or Tri-Rail. Using data contained in the table, the authors calculated a 75% transfer rate for rail patrons (36% access plus 39% egress).

Table 73 Access/egress methods for MDT Metro Rail riders

Method	Access Percent	Egress Percent
Walked 0–3 blocks	26	31
Walked more than 3 blocks	10	10
Was passenger in car	10	6
Rode bicycle	1	1
Drove my car	18	12
Transferred from Metromover	6	9
Transferred from Tri-Rail	3	2
Transferred from Metrobus	27	28
Other	3	3

Source: Petra Brock and Robert Ladner, *Summary of Ridership Patterns of Metrorail Riders in Miami-Dade County*, Miami-Dade Transit, June 2005, p. 10–11.

The on-board survey of Metrobus riders also asked participants about their attitude towards transfers. Table 74 shows that most Metrobus passengers are not bothered by transfers. Only 3% of passengers reported that if they had to transfer, they would not use public transportation.

Table 74 MDT bus rider attitudes toward transferring

How Do You Feel About Transfers?	Total Percent
Transferring does not bother me	66
One transfer is all right, but not more than one	19
I would prefer to not make any transfers	12
If I have to transfer, I will not use public transportation	3

Source: Petra Brock and Robert Ladner., *Summary of Ridership Patterns of Metrobus Riders in Miami-Dade County, Miami-Dade Transit*, June 2005, p. 8.

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

Using data obtained from the National Transit Database and U.S. Census Bureau, the authors examined riding habit and service productivity on a metropolitan area-wide basis in Miami.

Since 1984, riding habit (measured as passenger miles per capita) has increased 30%. The riding habit increases correspond with service additions and changes to fare and transfer policy (see Figure 74). Over the same period, service productivity (measured as the ratio of passenger miles to vehicle miles, or load factor) has declined by 9% (see Figure 75). The decline in service productivity reflects the national decline in this measure or service performance.

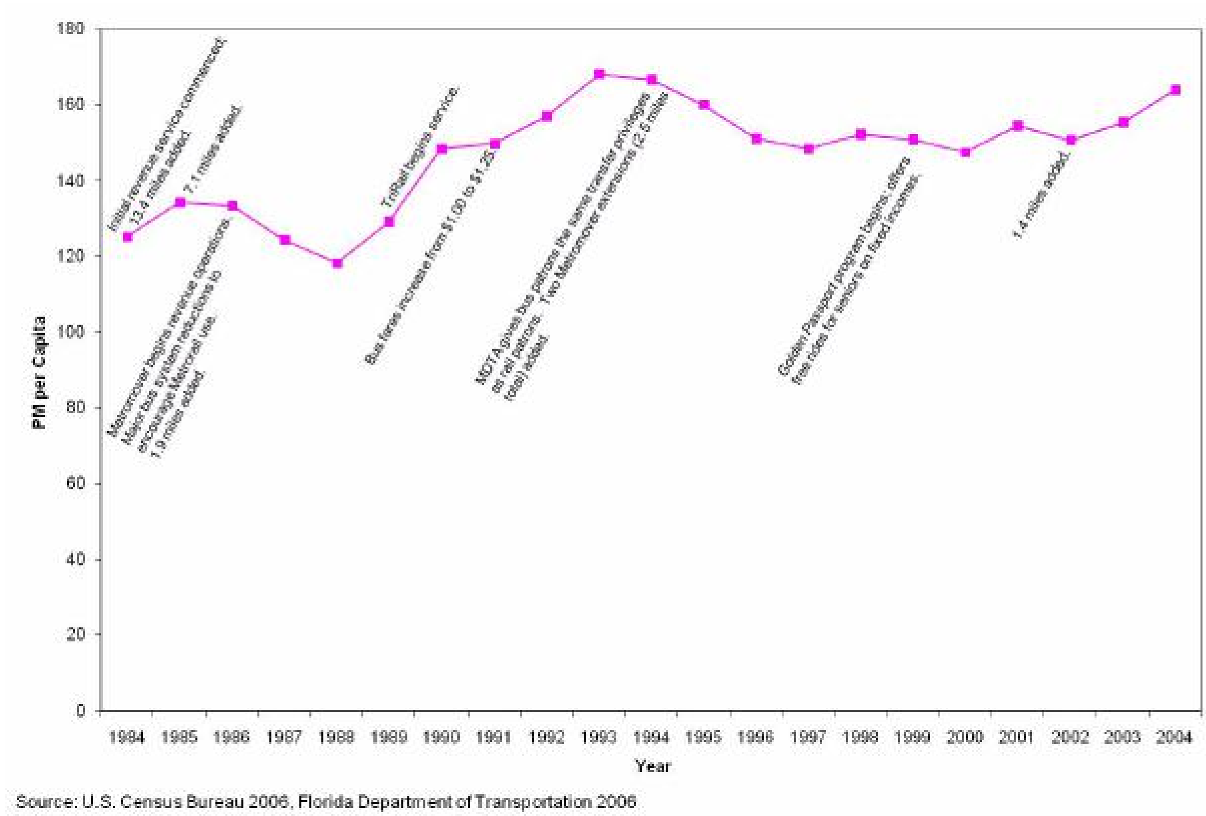


Figure 74 Miami MSA riding habit (passenger miles per capita) (1984-2004)

MDT System Ridership and Productivity Trends

Table 75 reports ridership by mode for Miami-Dade Transit from 1984 to 2004. The table shows that ridership has fluctuated over this time period. Measured as passenger miles, bus ridership is relatively unchanged since 1984, but measured as unlinked passenger trips it has increased considerably. The difference in these two measures is explained by service restructuring necessitating the use of transfers. Rail ridership has experienced a modest increase, particularly since the mid-1990s. The recent ridership spike (in 2004) is likely due to increased service resulting from passage of the People's Transportation Plan amendment in 2002. Since that time, the interviewees report that the amount and quality of service has declined.

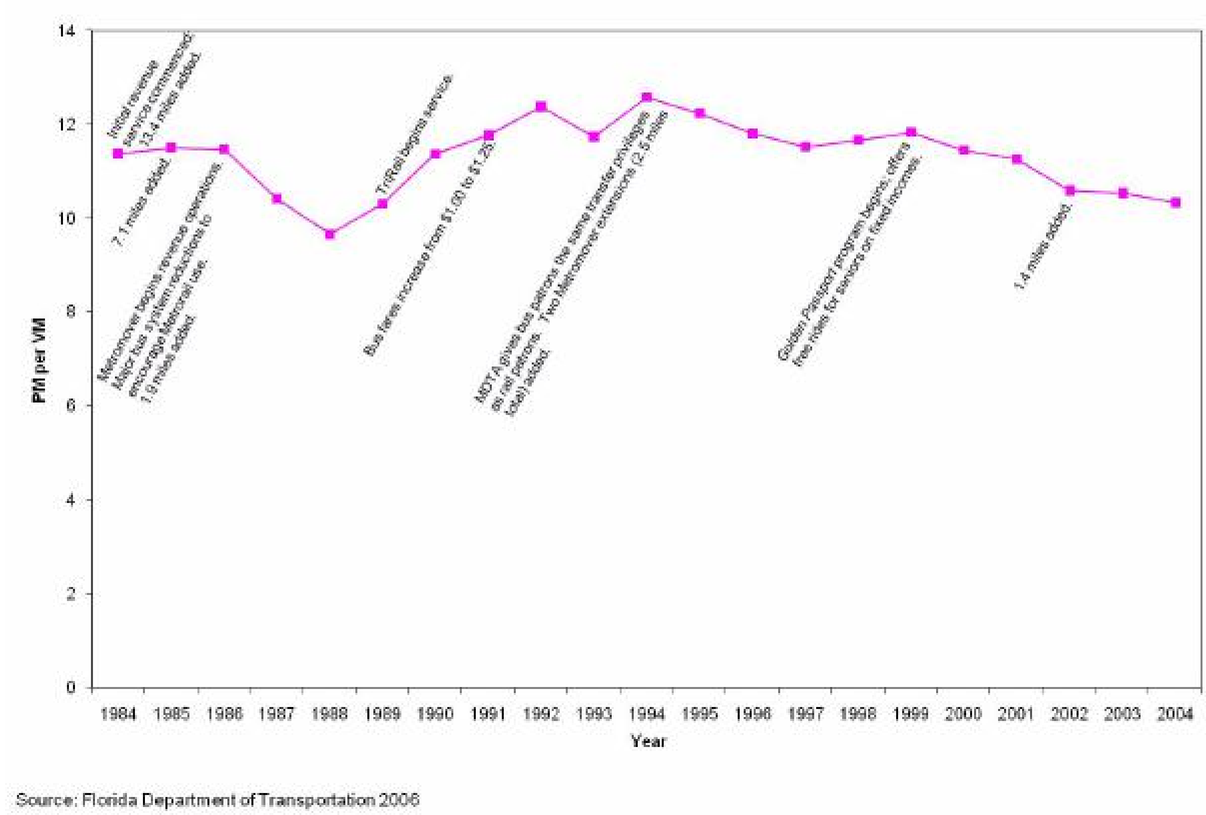


Figure 75 Miami MSA load factor (passenger miles per vehicle mile) (1984–2004)

Table 75 Ridership on MDT fixed route transit services (1984–2004)

Year	Passenger Miles				Passenger Trips			
	Bus	Heavy Rail	Automated Guideway	Total	Bus	Heavy Rail	Automated Guideway	Total
1984	279,890,118	6,056,175		285,946,293	63,867,617	771,389		64,639,006
1985	266,870,556	39,338,350		306,208,906	61,831,214	4,856,606		66,687,820
1986	246,351,090	67,979,300	1,033,900	315,364,290	59,650,300	7,668,166	1,360,753	68,679,219
1987	231,092,690	79,873,000	2,487,000	313,452,690	59,261,670	10,187,890	3,271,920	72,721,480
1988	198,493,550	81,584,650	2,402,700	282,480,900	53,199,220	10,406,220	3,161,200	66,766,640
1989	228,419,212	95,449,870	2,827,166	326,696,248	59,688,237	12,127,900	3,305,000	75,121,137
1990	248,347,583	109,692,672	2,723,962	360,764,217	59,773,110	13,621,918	3,234,723	76,629,751
1991	228,189,755	114,331,310	2,771,354	345,292,419	56,279,726	13,906,539	3,229,032	73,415,297
1992	236,373,858	109,689,014	2,589,961	348,652,833	55,895,195	13,701,605	2,682,461	72,279,261
1993	262,865,489	117,329,023	2,522,120	382,716,632	70,001,630	14,817,894	2,343,571	87,163,095
1994	258,038,816	113,675,344	3,623,100	375,337,260	63,765,755	14,328,714	3,587,609	81,682,078
1995	246,863,116	115,387,327	4,456,044	366,706,487	62,257,868	14,204,030	4,325,632	80,787,530
1996	248,519,496	112,665,623	4,226,423	365,411,542	61,405,604	14,386,185	3,962,302	79,754,091
1997	254,097,031	108,155,854	4,278,760	366,531,645	62,013,539	14,019,934	4,118,978	80,152,451
1998	280,715,186	104,301,738	4,078,056	389,094,980	62,269,585	13,482,522	4,052,881	79,804,988
1999	284,161,882	107,591,590	4,166,830	395,920,302	63,827,287	13,604,528	4,052,129	81,483,944
2000	270,212,681	110,086,397	4,407,744	384,706,822	65,821,048	14,080,200	4,230,225	84,131,473
2001	283,461,510	107,648,751	5,095,761	396,206,022	65,413,709	13,735,320	4,856,220	84,005,249

Table 75 Ridership on MDT fixed route transit services (1984–2004)

Year	Passenger Miles				Passenger Trips			
	Bus	Heavy Rail	Automated Guideway	Total	Bus	Heavy Rail	Automated Guideway	Total
2002	273,613,961	107,822,476	4,892,343	386,328,780	63,369,445	13,753,595	4,768,386	81,891,426
2003	279,410,583	109,218,683	6,391,523	395,020,789	64,546,632	14,306,084	6,229,321	85,082,037
2004	296,888,711	121,822,960	7,910,898	426,622,569	75,137,426	15,637,516	7,768,509	98,543,451

Source: Florida Department of Transportation, 2006.

Table 76 uses the passenger mile and passenger trip data presented in Table 75 to calculate the average trip length for MDT patrons using the various modes. The most striking feature of the table is how very little trip lengths have changed since the mid-1980s. The average bus trip has declined slightly, but most of the change occurred between 2003 and 2004. The average heavy rail trip is relatively unchanged. The average Metro Mover trip has increased slightly, undoubtedly due to the extension of the system.

Since 1984, MDT has added more service, although the interviewees characterized this service as inadequate to provide high quality service, particularly for bus riders. Table 77 shows that bus vehicle miles have increased by more than 50% since 1984, heavy rail vehicle miles have expanded dramatically as the system segments opened, and automated guideway vehicle miles have also increased dramatically as that system was expanded.

Service increases exceeded the ridership increases reported earlier resulting in declining productivity, particularly for the bus system (see Table 78). Bus service productivity has fallen 30% since 1984, although there were two periods of increased service productivity that are suggestive of effective service changes. Rail service productivity is relatively unchanged, while automated guideway service productivity increased significantly between 2003 and 2004.

Table 76 Average trip lengths (MDT) (1984–2004)

Year	Average Trip Length (1984–2004)			
	Bus	Heavy Rail	Automated Guideway	Total
1984	4.38	7.85		4.42
1985	4.32	8.10		4.59
1986	4.13	8.87	0.76	4.59
1987	3.90	7.84	0.76	4.31
1988	3.73	7.84	0.76	4.23
1989	3.83	7.87	0.86	4.35
1990	4.15	8.05	0.84	4.71
1991	4.05	8.22	0.86	4.70
1992	4.23	8.01	0.97	4.82
1993	3.76	7.92	1.08	4.39
1994	4.05	7.93	1.01	4.60
1995	3.97	8.12	1.03	4.54
1996	4.05	7.83	1.07	4.58

Table 76 Average trip lengths (MDT) (1984–2004)

Year	Average Trip Length (1984–2004)			
	Bus	Heavy Rail	Automated Guideway	Total
1997	4.10	7.71	1.04	4.57
1998	4.51	7.74	1.01	4.88
1999	4.45	7.91	1.03	4.86
2000	4.11	7.82	1.04	4.57
2001	4.33	7.84	1.05	4.72
2002	4.32	7.84	1.03	4.72
2003	4.33	7.63	1.03	4.64
2004	3.95	7.79	1.02	4.33

Source: Florida Department of Transportation, 2006.

Table 77 MDT fixed route transit service (1984–2004)

Year	Vehicle Miles			
	Bus	Heavy Rail	Automated Guideway	Total
1984	23,476,329	478,400		23,954,729
1985	22,045,550	3,681,588		25,727,138
1986	20,527,200	4,593,000	150,950	25,271,150
1987	21,144,470	4,865,000	392,000	26,401,470
1988	21,373,440	5,149,010	399,850	26,922,300
1989	22,501,723	4,745,914	359,482	27,607,119
1990	24,091,921	5,575,130	371,527	30,038,578
1991	24,107,598	5,597,923	419,491	30,125,012
1992	24,694,887	5,382,882	408,726	30,486,495
1993	30,180,770	5,515,004	387,142	36,082,916
1994	26,398,234	5,665,897	616,306	32,680,437
1995	26,518,624	5,841,065	732,999	33,092,688
1996	26,187,248	6,005,576	868,604	33,061,428
1997	27,404,762	5,884,955	979,230	34,268,947
1998	27,868,781	6,212,429	924,482	35,005,692
1999	28,034,428	6,176,064	997,201	35,207,693
2000	27,871,134	6,144,445	1,029,195	35,044,774
2001	29,365,753	7,433,032	1,004,228	37,803,013
2002	30,559,197	7,549,172	1,028,215	39,136,584
2003	32,075,895	7,865,664	1,048,524	40,990,083
2004	36,037,702	9,261,523	973,315	46,272,540

Source: Florida Department of Transportation, 2006.

Table 78 MDT service productivity (1984–2004)

Year	Bus	Heavy Rail	Automated Guideway	Total
1984	11.92	12.66		11.94
1985	12.11	10.69		11.90
1986	12.00	14.80	6.85	12.48
1987	10.93	16.42	6.34	11.87
1988	9.29	15.84	6.01	10.49
1989	10.15	20.11	7.86	11.83
1990	10.31	19.68	7.33	12.01
1991	9.47	20.42	6.61	11.46
1992	9.57	20.38	6.34	11.44
1993	8.71	21.27	6.51	10.61
1994	9.77	20.06	5.88	11.49
1995	9.31	19.75	6.08	11.08
1996	9.49	18.76	4.87	11.05
1997	9.27	18.38	4.37	10.70
1998	10.07	16.79	4.41	11.12
1999	10.14	17.42	4.18	11.25
2000	9.70	17.92	4.28	10.98
2001	9.65	14.48	5.07	10.48
2002	8.95	14.28	4.76	9.87
2003	8.71	13.89	6.10	9.64
2004	8.24	13.15	8.13	9.22

MDT Bus Route Performance Analysis

The authors obtained route-based bus system performance statistics for Miami-Dade Transit. MDT classifies routes into categories, based on the type of service provided. The authors separated the routes into local routes, express routes, and an "other" category that includes circulators, shuttles, and owl (all-night) service. They also distinguish among routes on the basis of whether they serve the Miami CBD or not. Of MDT's 106 bus routes for which they could obtain detailed performance data, 34 routes serve the CBD. These routes account for about 40% of the agency's transit service. As this study's measures of bus route performance, the authors use both passenger trips per revenue mile and passenger trips per revenue hour. These data are available for the average weekday.

Table 79 provides the results of the analysis. The table shows that CBD-serving routes outperform their non-CBD-serving counterparts for all route types on both performance measures. However, for local routes the difference in performance between CBD-serving and non-CBD routes is not large. Among the route types, local routes are the strongest performers, followed by express routes, and then "other" routes.

The finding that CBD-serving routes outperform the non-CBD-serving routes is not surprising, but should be interpreted with caution. The Miami CBD is an important travel destination for bus patrons. One of the interviewees observed that perhaps 25,000 bus riders per day travel to the Miami CBD. However, many of these CBD-serving routes run along major arterial roads with their own travel destinations, so many riders on the high-performing routes may not be bound for the CBD. Stop-based boarding and alighting data, or a more sophisticated on-board survey, would be required to more carefully assign riders (by route) to destinations. These data were not available for this study of Miami.

Table 79 MDT bus route average weekday performance

Route Type	Number of Routes	Passenger Trips per Revenue Mile (median route)	Passenger Trips per Revenue Hour (median route)
All routes	106	1.60	22.11
All non-CBD routes	72	1.29	15.86
All non-CBD local routes	41	1.75	22.85
All non-CBD express routes	12	0.92	15.86
All non-CBD circulators/shuttles/owls	19	1.06	10.94
All CBD-serving routes	34	2.51	30.39
All CBD-serving local routes	23	2.89	28.83
All CBD-serving express routes	4	2.43	33.40
All CBD-serving circulators/shuttles/owls	7	0.92	14.22

Source: Miami-Dade Transit, 2007b.

MDT Rail Station Entries

For a few study cities, the authors were able to obtain detailed information about rail passenger activity, by time of day and direction of travel. This is not the case for Miami, where more limited information is available. Nevertheless, these data corroborate the story told through the interviews and other data the authors obtained from the transit agencies.

The authors obtained data on average weekday boardings (by station) for Metro Rail and Metro Mover services. Figure 76 maps average weekday boardings on Metro Rail in 2007. The most striking thing about the map is the fact that the busiest stations are located in the Miami CBD and along the southern segment of the line. There is relatively little boarding activity in the northern portion of the system.

Figure 77 focuses on average weekday boardings by station for Metro Mover, the automated system that circulates through the Miami CBD. The map indicates that most stations have relatively modest boarding activity, save for the Government Center station (a transfer point to Metro Rail) and Bayfront Park. The sense from the interviews is that Metro Mover is a relatively underutilized asset, and these boarding statistics corroborate that proposition.

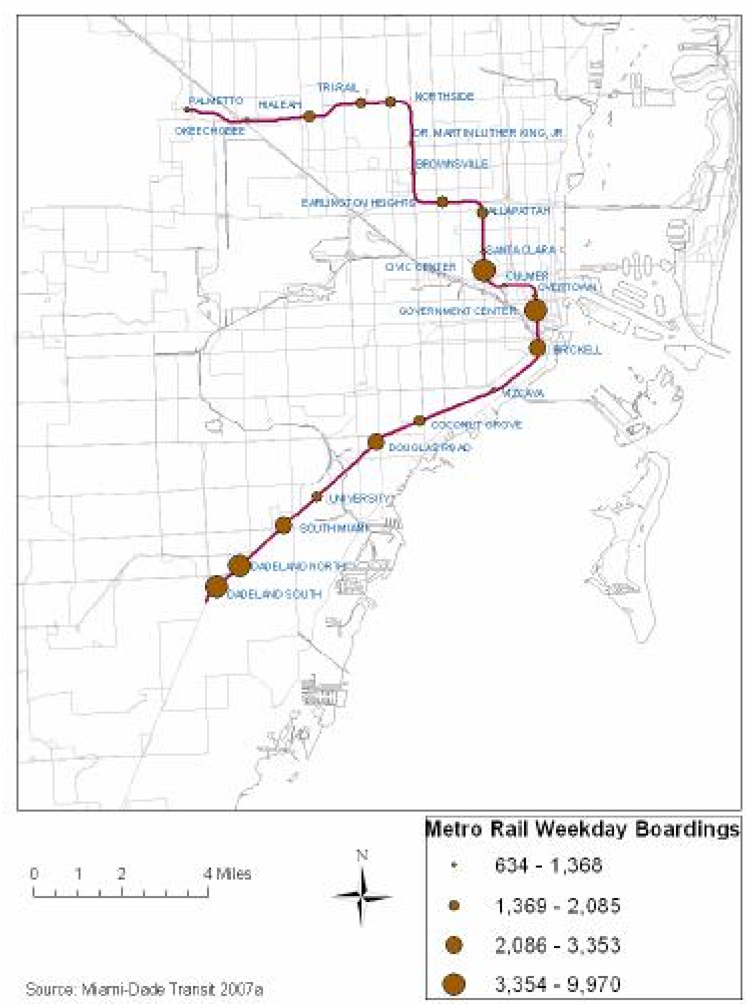


Figure 76 Metro rail average weekday boardings by station (2007)

Emerging and Declining Ridership Markets

The study's interviewees noted that the transit agencies in Miami are saturated with transit-dependent riders and attempting to attract choice riders. The area's focus on rail transit development can be seen as a major part of this strategy. Unfortunately, resource limitations, including uncertainty in Florida about property tax revenues, have meant that agencies are tending to reduce service rather than increase it in recent years. (The data shown in the service table include the period 1984 to 2004.) This shift has negative effects on the agencies' ability to attract choice riders and effectively serve their transit-dependent customers. The interviewees observed that agencies in Miami have many poor performing bus routes, and thus have some potential efficiency gains they could achieve, but that there is an unwillingness to delete these services.

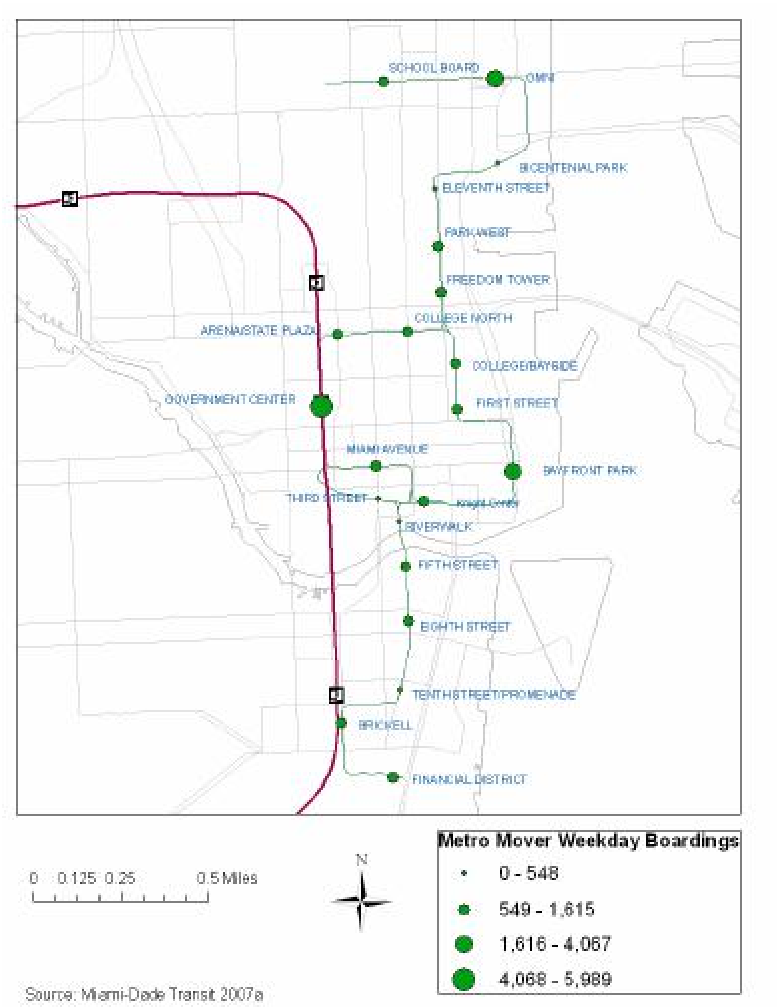


Figure 77 Metro Mover average weekday boardings by station (2007)

The systems have also made decisions that are poor in terms of generating new ridership. The rail system is a particular focus of attention, where political decisions about alignments led the Miami area to build its heavy rail system in areas for which it was inappropriate. This is particularly true in the northern section of the system where one of the interviewees reported that some station boardings are only 10% of the initial forecast. According to the interviewees, the decision to locate stations here was part of a political strategy to use transit as an economic revitalization catalyst in a very depressed area. Unfortunately, this initiative has failed, leaving this part of the rail system devoid of ridership.

Other decisions have had positive effects on ridership and productivity, including bus restructuring. In Broward County, BCT undertook a major restructuring that removed service from neighborhoods and placed it on arterials. One of the interviewees noted that in 1986, BCT had 205 buses and carried 50,000 passengers. In 2000, they had 205 buses and carried 100,000 passengers. The cost per trip was down to $1.80. The key to BCT's success is high frequency service on its arterial roads. Indeed, arterial roads with strip commercial development are sizeable ridership markets in the Miami MSA, which BCT has successfully tapped in corridors like U.S. Route 441 (a north-south arterial) and U.S. Route 1 (also a north-south route), the sites of its two most heavily patronized routes. MDT's experience with Network 86 has made the agency much more cautious about restructuring its service. But overall, Network 86 was a very productive, if painful, change.

Neighborhood circulator services, on the other hand, tend to be a declining market-as suggested by the poor performance of MDT's circulator routes and the decisions of some communities in Broward County to eliminate their circulator services.

Transit and Development

The Miami area has seen the emergence of several transit-oriented developments (TOD) near its rail transit stations. According to the interviewees, the most successful of these developments is near the South Dadeland station where a mixed use development has emerged. At Dadeland North station, a vertical big box retail development has emerged, some of whose patrons access the development by transit. The Florida Department of Transportation has begun to promote TOD and has signed agreements to develop office and residential uses on two park and ride lots it owns in Broward County.

The interviewees suspected that TOD was generating ridership, although there has been no study of ridership at TOD in Miami. One of the interviewees also emphasized that providing more parking capacity for park-and-ride users was a more immediate priority than TOD. Another interviewee observed that too much of what passes for TOD is catering to an upscale market that does not use transit. This contact emphasized that affordable housing was required to make TOD successful.

Public Attitude Toward Transit

The general public has expressed a willingness to tax itself to support public transit, most recently in the 2002 People's Transportation Plan Initiative in Miami-Dade County. However, the interviewees have also observed that the public tends to be skeptical of its government. This skepticism is especially strong in Miami-Dade County, which has a history of public sector corruption. Concern about corruption and accountability prompted supporters of the People's Transportation Plan initiative to include the creation of a watchdog Citizens Independent Transportation Trust (CITT) as part of the ballot measure. CITT's objective was to ensure that money raised from the new sales tax would be used to fund the projects promised in the ballot measure.

The study's interviewees offered a mixed assessment of CITT's performance. One contact thought CITT had become a barrier to transit development because it rigidly required that MDT develop exactly what had been promised in 2002, despite the passage of time and changing circumstances. Another contact, however, felt that CITT had been ineffective and had become overpowered by the County Commission.

DISCUSSION

The authors' analysis indicates that policymakers have made a number of decisions that have both enhanced and hindered transit's potential for success in the Miami metropolitan area. Among the most significant, and successful, policy decisions were the restructuring of the local bus systems in both Broward and Miami-Dade Counties from CBD-focused radial systems to multidestination grid systems. Bus service restructuring by Broward County Transit led to significant increases in both ridership and service productivity. Bus service restructuring by Miami-Dade Transit, under the Network 86 initiative, also led to increased ridership and improved service productivity. However, the political difficulties encountered during the implementation of Network 86 have prevented MDT from undertaking other major service restructuring initiatives that might also have led to improved performance.

The authors' sense is that rail transit has been an important factor in transit planning and policymaking, but that policy decisions about rail routing and overall transit funding levels have compromised rail's ability to play the positive, leading role in transit system development envisioned by its proponents. On the positive side, it is clear that the necessary bus service restructuring carried out in Miami as part of Network 86 would not have been considered had not Metro Rail been in existence. The rail transit investment provided an opportunity for the transit agency to reconsider the structure of its entire transit network to seek out opportunities for service efficiencies.

However, policy decisions have also hindered rail transit. First, the original concept of placing Metro Rail in high-demand corridors was compromised by political decisions about rail routing. The first important political decision was to develop only two of the originally proposed seven rail corridors, only one of which had significant ridership potential. The second important political decision was to use the rail transit investment as a means of stimulating development in a corridor that lacked ridership potential. Unfortunately, the hoped-for development (and associated ridership) has still not materialized in this corridor, which is the northern portion of the Metro Rail alignment (see Figure 78, which shows the MDT bus and rail system overlaid on the map of employment density shown earlier).

Second, the Metro Rail investment has been compromised by funding difficulties for Miami-Dade Transit. Funding difficulties have resulted in reduced overall service and deteriorating service reliability, despite the infusion of money through the People's Transportation Plan. Funding difficulties have led to serious maintenance backlogs in both the MDT bus and rail systems. Given these liabilities, the rail investment has worked remarkably well in serving as a means of allowing MDT to restructure its network to better serve an increasingly decentralized set of travel destinations while also supporting a growing CBD.

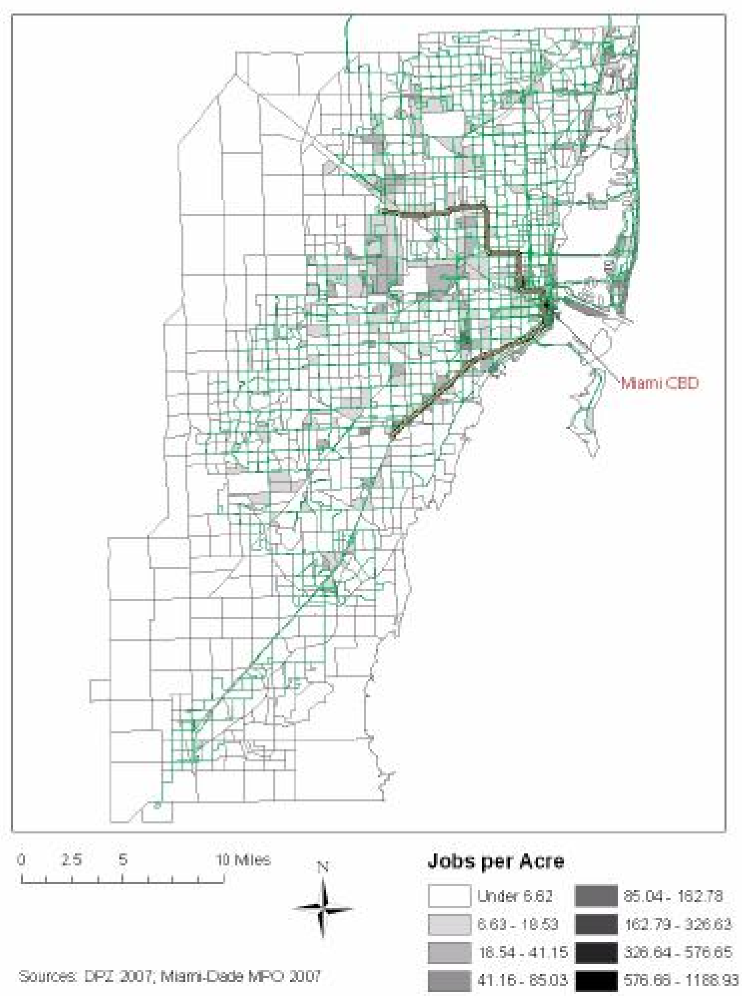


Figure 78 Miami MTD transit system and its relation to employment (2005)

The development of Metro Mover also points to the limitations of transit planning in the Miami area. Based on the authors' analysis, it would have been desirable not to require CBD-bound Metro Rail passengers to transfer to reach their final destinations, as the location of the Metro Rail alignment does. In addition a large amount of capital and operating expense could have been avoided had Metro Rail penetrated the CBD rather than pass it on one side. However, the authors accept that sending Metro Rail through the CBD on an elevated structure would have been difficult, and a subway quite costly, so Metro Mover may have been the most feasible option. Because its cost is high and its productivity low, the authors do not recommend that grade-separated downtown circulation systems be embraced in other regions. Something like the bus mall in Denver may be a much more cost-effective solution to providing high-quality regional transit connected to the CBD without compromising its performance or making it cost-prohibitive by going directly through the CBD.

The most striking finding from this examination of transit in Miami is the absence of regional transit planning, regional service coordination, or regional transit services. The creation of

SFRTA may help to facilitate regional transit planning and service coordination, while improvements to Tri-Rail might facilitate the development of regional transit service. Since its inception, Tri-Rail's service has been too irregular, infrequent, and unreliable to be more than a commuter rail service that is largely isolated from the rest of the transit network in the Miami MSA. Now that Tri-Rail's double-tracking program is complete, however, the authors anticipate that service frequency improving to the point where the line is beginning to function more like a regional rapid transit line such as a BART or WMATA line. As such it has the potential of knitting together the local bus lines in Miami-Dade, Broward, and Palm Beach Counties. Its utility in this regard would be increased if it is extended south (as planned) to the southern part of Dade County.

APPENDIX E
MINNEAPOLIS–ST. PAUL, MINNESOTA

SETTING

The Minneapolis-St. Paul metropolitan statistical area (MSA) consists of eleven counties in southeastern Minnesota and two counties in western Wisconsin with a total land area of just over 6,050 square miles.[162] With 3.1 million persons in 2005, the Minneapolis-St. Paul MSA ranks as the nation's 16th largest in population.[163] The MSA's population density is just over 519 persons per square mile.

Two counties represent the historic center of the MSA: Hennepin and Ramsey (see Figure 79). Hennepin County contains the city of Minneapolis, the MSA's largest city, while Ramsey County contains the city of St. Paul, the state capital. Three other counties, Anoka, Dakota, and Washington, are also important centers of population and employment. This report refers to these five counties as the MSA core counties, while it refers to Hennepin and Ramsey as the MSA inner core counties.

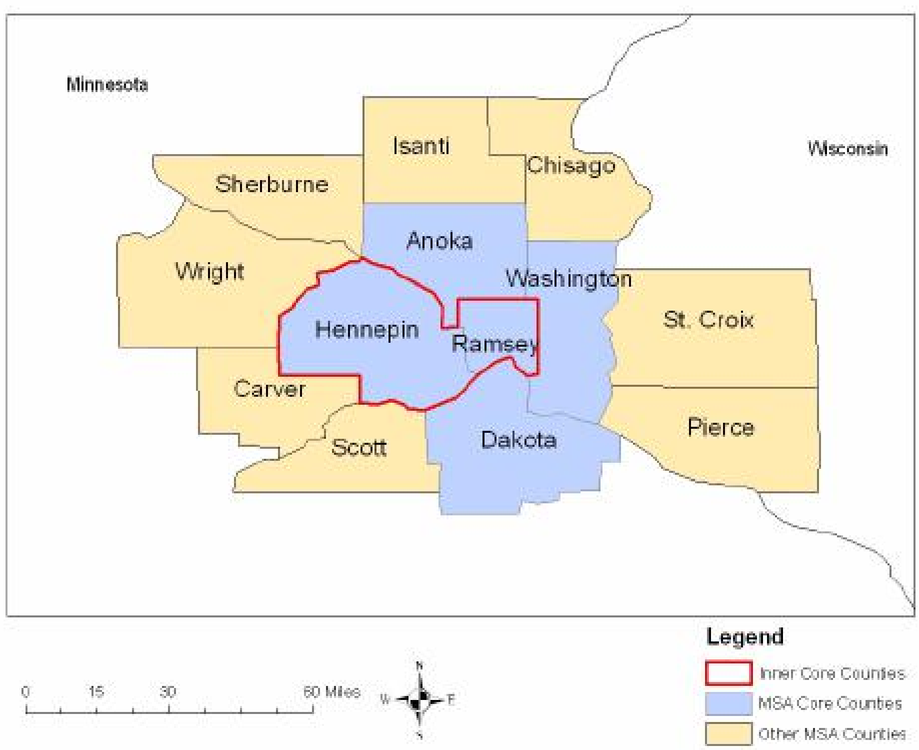


Figure 79 Minneapolis-St. Paul metropolitan statistical area

Distribution of MSA Population

The Minneapolis-St. Paul MSA is a steadily growing, and increasingly decentralized, metropolitan area. Population has decentralized since 1970, as shown in Figure 80. This figure provides maps of population by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of population from Hennepin and Ramsey Counties to the other three MSA core counties. The other eight MSA counties combined account for less than 20% of the MSA population. Population density averages 2,266 persons per square mile across the inner core counties, 675 persons per square mile across the other three core counties, and 151 persons per square mile across the non-core MSA counties.

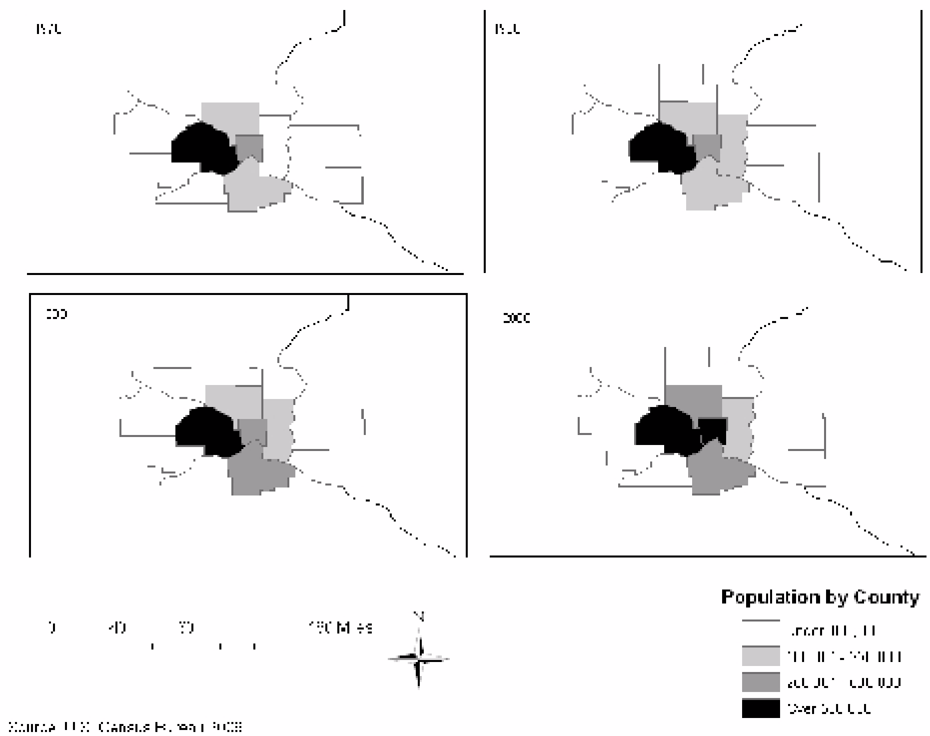


Figure 80 Minneapolis-St. Paul MSA: population by county (1970–2000)

Between 1970 and 2005, total MSA population increased 142% from around 2 million to just over 3.1 million persons (see Table 80). Population growth was very uneven across the MSA. The inner core counties registered very modest population growth (12%) compared to the other three MSA core counties (146%) and the non-core MSA counties (199%). While the inner core counties accounted for 71% of the MSA population in 1970, they accounted for slightly more than half of the MSA population in 2005.

The authors were able to obtain more detailed population data for seven counties for 2005. Using these data the authors constructed maps of population density (persons per acre) by transportation analysis zone (TAZ). Figure 81 displays population density for the five MSA core counties, plus two adjacent counties, in 2005. The map uses classification categories based on natural breaks in the data. The map shows that population clusters are largely confined to the core of the seven counties. Population is decentralized within the center of the region, with larger population concentrations corresponding to the two major cities. There are also a handful of population clusters in suburban areas that lie primarily to the west of the two major cities.

Table 80 Population in the Minneapolis-St. Paul metropolitan area

Year	MSA Inner Core Counties (2 counties)	MSA Core Counties (5 counties)	Other MSA Counties (8 counties)	Total MSA (13 counties)
1970	1,436,335	1,813,858	200,957	2,014,815
1971	1,438,200	1,827,800	209,200	2,037,000
1972	1,417,000	1,820,700	218,400	2,039,100
1973	1,406,100	1,828,800	227,800	2,056,600
1974	1,403,600	1,841,200	234,700	2,075,900
1975	1,396,400	1,841,200	257,000	2,098,200
1976	1,390,700	1,849,800	262,500	2,112,300
1977	1,386,500	1,853,800	269,100	2,122,900
1978	1,385,700	1,865,100	278,500	2,143,600
1979	1,387,500	1,881,000	286,700	2,167,700
1980	1,401,195	1,905,043	293,147	2,198,190
1981	1,418,293	1,935,125	299,529	2,234,654
1982	1,429,242	1,956,097	303,838	2,259,935
1983	1,436,116	1,969,357	305,324	2,274,681
1984	1,442,755	1,988,181	309,604	2,297,785
1985	1,459,458	2,018,821	315,164	2,333,985
1986	1,476,311	2,051,110	320,601	2,371,711
1987	1,486,245	2,083,520	329,216	2,412,736
1988	1,502,308	2,126,793	340,481	2,467,274
1989	1,512,315	2,157,270	348,713	2,505,983
1990	1,521,663	2,191,724	358,136	2,549,860
1991	1,531,497	2,222,318	367,229	2,589,547
1992	1,541,733	2,254,072	377,264	2,631,336
1993	1,551,913	2,286,171	390,077	2,676,248
1994	1,562,644	2,315,726	402,303	2,718,029
1995	1,572,789	2,344,295	415,438	2,759,733
1996	1,582,083	2,372,326	429,004	2,801,330
1997	1,592,208	2,399,032	442,970	2,842,002
1998	1,605,077	2,428,738	455,921	2,884,659
1999	1,618,809	2,460,319	471,949	2,932,268
2000	1,627,235	2,482,353	486,453	2,968,806
2001	1,635,017	2,511,512	511,884	3,023,396

Table 80 Population in the Minneapolis-St. Paul metropolitan area

Year	MSA Inner Core Counties (2 counties)	MSA Core Counties (5 counties)	Other MSA Counties (8 counties)	Total MSA (13 counties)
2002	1,629,582	2,518,874	535,266	3,054,140
2003	1,624,426	2,525,681	557,574	3,083,255
2004	1,619,072	2,533,116	579,761	3,112,877
2005	1,614,284	2,542,298	600,481	3,142,779

Source: U.S. Census Bureau, 2007.

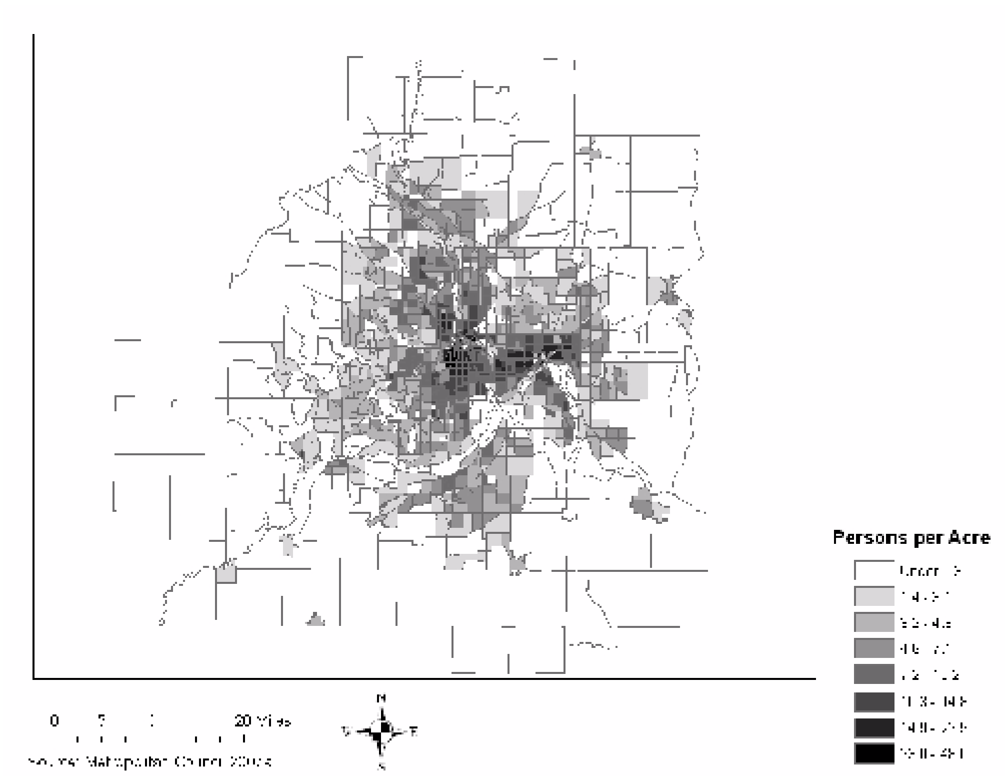


Figure 81 Minneapolis-St. Paul core area: population density by transportation analysis zone (2005)

Distribution of MSA Employment

Employment has also increased and decentralized since 1970 (see Figure 82). The maps displayed in this figure plot employment by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of employment from Hennepin and Ramsey Counties to Anoka and Dakota Counties. The eight non-core MSA counties combined account for less than 15% of MSA employment.

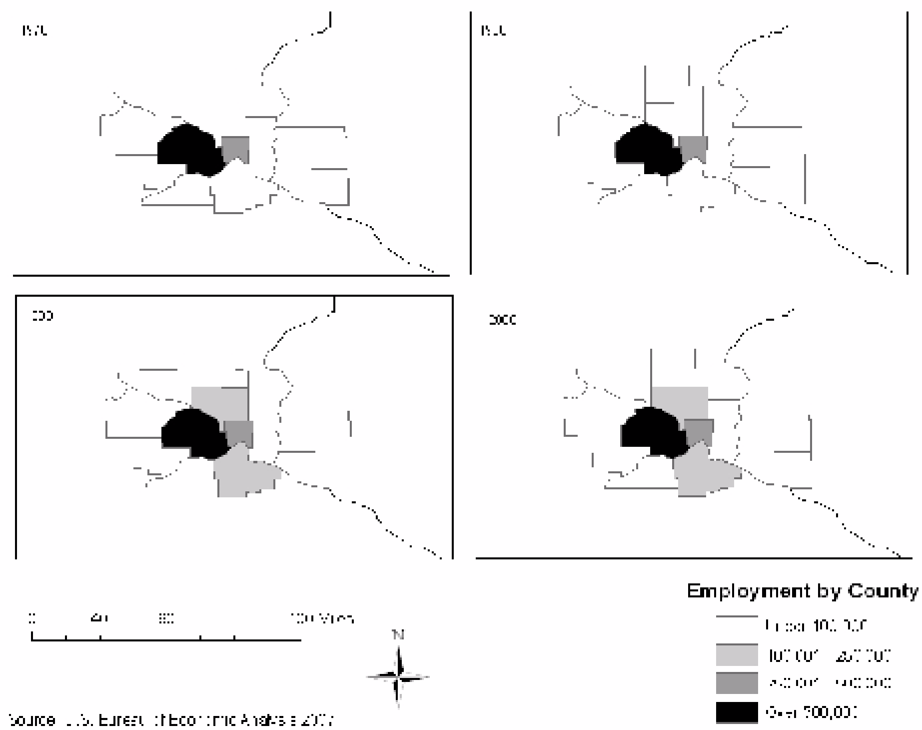


Figure 82 Minneapolis-St. Paul MSA: employment by county (1970-2000)

Total MSA employment has increased more rapidly than population. Between 1970 and 2005, total MSA employment increased 127% from fewer than 1 million to more than 2.2 million jobs (see Table 81). Employment growth in the MSA inner core counties has been slower (77%) than employment growth in the other core counties (421%) and the MSA non-core counties (326%). All employment growth in the two inner core counties has occurred outside the Minneapolis CBD. The Minneapolis CBD experienced a 19% decline in employment between 1970 and 2005. Local planners and policymakers consider the Minneapolis CBD the primary of three major historic employment centers in the metropolitan area. The two other centers are the St. Paul CBD to the east, and the area around the University of Minnesota that lies midway between the Minneapolis CBD and St. Paul CBD.

The authors obtained more detailed employment data by TAZ for seven counties in the core of the metropolitan area. Using these data, they mapped employment density (jobs per acre) by TAZ. Figure 83 shows that employment is decentralized throughout the center of the Minneapolis-St. Paul MSA. However, employment tends to be clustered. The cluster in the Minneapolis CBD is visible and labeled. The employment cluster associated with the St. Paul

CBD is visible to the east of the Minneapolis CBD, and the employment cluster associated with the Mall of America and the airport is visible to the south of the Minneapolis CBD.

Table 81 Employment in the Minneapolis-St. Paul metropolitan area (1970–2005)

Year	MSA Inner Core Counties (2 counties)			MSA Core Counties (5 counties)	Other MSA Counties (8 counties)	Total MSA (13 counties)
	Minneapolis CBD	Outside Minneapolis CBD	Total			
1970	86,157	734,453	820,610	914,008	67,103	981,111
1971	87,846	721,787	809,633	908,627	69,255	977,882
1972	89,567	741,534	831,101	940,208	76,033	1,016,241
1973	91,323	781,156	872,479	993,188	81,134	1,074,322
1974	93,113	795,148	888,261	1,016,293	83,641	1,099,934
1975	94,938	777,458	872,396	1,005,686	86,284	1,091,970
1976	96,799	796,388	893,187	1,033,107	90,484	1,123,591
1977	98,696	827,921	926,617	1,077,925	95,855	1,173,780
1978	100,630	865,168	965,798	1,131,228	102,243	1,233,471
1979	102,603	916,038	1,018,641	1,197,566	108,848	1,306,414
1980	104,653	937,592	1,042,245	1,226,240	111,672	1,337,912
1981	102,968	936,048	1,039,016	1,225,162	111,930	1,337,092
1982	101,310	918,967	1,020,277	1,206,320	111,463	1,317,783
1983	99,679	929,345	1,029,024	1,223,050	114,194	1,337,244
1984	98,074	996,186	1,094,260	1,306,667	120,670	1,427,337
1985	96,495	1,033,580	1,130,075	1,354,673	126,658	1,481,331
1986	94,942	1,057,257	1,152,199	1,386,943	130,436	1,517,379
1987	93,413	1,102,584	1,195,997	1,450,739	137,276	1,588,015
1988	91,909	1,133,209	1,225,118	1,497,377	142,694	1,640,071
1989	90,430	1,153,570	1,244,000	1,527,913	148,174	1,676,087
1990	89,000	1,168,555	1,257,555	1,552,458	155,961	1,708,419
1991	87,407	1,161,744	1,249,151	1,552,073	162,203	1,714,276
1992	85,842	1,172,776	1,258,618	1,570,620	170,521	1,741,141
1993	84,306	1,194,673	1,278,979	1,599,833	178,983	1,778,816
1994	82,797	1,225,776	1,308,573	1,646,453	189,596	1,836,049
1995	81,315	1,260,610	1,341,925	1,694,803	200,184	1,894,987
1996	79,859	1,281,712	1,361,571	1,727,824	206,963	1,934,787
1997	78,430	1,301,350	1,379,780	1,758,270	213,647	1,971,917
1998	77,026	1,336,701	1,413,727	1,806,319	217,988	2,024,307
1999	75,647	1,357,181	1,432,828	1,846,625	228,788	2,075,413
2000	74,285	1,381,735	1,456,020	1,885,771	240,694	2,126,465
2001	72,955	1,374,676	1,447,631	1,891,227	251,394	2,142,621
2002	71,649	1,348,423	1,420,072	1,870,672	260,504	2,131,176
2003	70,367	1,339,904	1,410,271	1,873,045	267,984	2,141,029
2004	69,107	1,353,164	1,422,271	1,894,908	277,123	2,172,031
2005	70,100	1,380,550	1,450,650	1,937,586	285,512	2,223,098

Source: U.S. Bureau of Economic Analysis, 2007; U.S. Census Bureau 1970, 1980, 1990, 2000.

The dispersed pattern of population and employment has clear implications for the structure of a successful transit system in the Minneapolis-St. Paul metropolitan area. The dispersed but clustered pattern of employment, in particular, necessitates the design of a decentralized transit system with strong service focused on the major activity centers that correspond to the employment clusters shown in Figure 83. The authors discuss the transit system in the Minneapolis-St. Paul metropolitan area later in the case study.

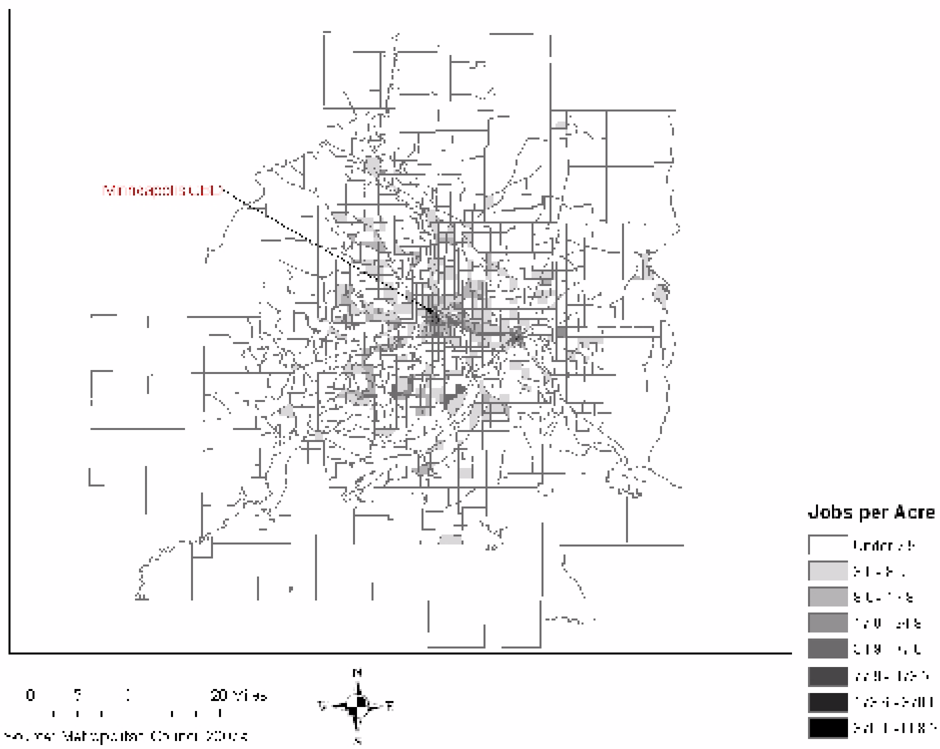


Figure 83 Minneapolis-St. Paul core area: employment density by transportation analysis zone (2005)

Institutions and Key Actors

A number of public-sector entities have played (and continue to play) important roles in transit policy in the Minneapolis-St. Paul, or Twin Cities, metropolitan area. These entities include Metro Transit, the Metropolitan Council, the County Railroad Authorities, and the State of Minnesota.

Metro Transit

Metro Transit is the primary public transit agency in the Twin Cities area. Metro Transit directly operates more than 110 bus routes and the Hiawatha Line light rail transit service. Metro Transit also serves as an organizing entity for service provided by a handful of newer suburban operators. Because the performance statistics for these operators are commingled with those for Metro Transit, and because the entity presents a single organizational face for the traveling public, this report treats all transit operators in the region who have their service listed with Metro Transit as part of Metro Transit. Metro Transit is a unit of the Metropolitan Council, the Twin Cities area's MPO.

Metropolitan Council

Metropolitan Council is the Twin Cities area's MPO. Metropolitan Council thus approves the federally-required short-range Transit Improvement Program (TIP) and Long Range Transportation Plan (LRTP) prepared by Metro Transit, which is part of the Metropolitan Council. Since 1994, Metropolitan Council has played the lead role in transit planning in the metropolitan area. Before 1994 Metropolitan Council competed with other organizations (most of which are now defunct) in developing the region's transit vision and plans. The Metropolitan Council is governed by a 17-member Board whose members are appointed by the Governor from 16 Metropolitan Council districts.

County Railroad Authorities

County Railroad Authorities play a role in preserving right of way for future potential light rail transit development. In the late 1980s and early 1990s these institutions played a more active role in developing rail transit plans.

State of Minnesota

The State of Minnesota plays a major role in transit development in the Twin Cities. At various points in time, the State has been a barrier to transit planning efforts and at other times, most notably in early 1999, state officials have been important champions of transit development.

Transit Agencies, Services, and Rider Profiles

There are six transit agencies located in the Minneapolis-St. Paul MSA: Maple Grove Transit, Minnesota Valley Transit Authority, Northstar Commuter Transit, Plymouth Metrolink, Southwest Metro Transit, and Metro Transit. For analysis purposes, this report will treat them as a single entity. These agencies all operate as part of a single Metro Transit system, and their ridership and performance statistics are lumped together in the National Transit Database. Therefore, separating statistics for individual entities within the overall Metro Transit system is a near-impossible task.

Modes and Services

Figure 84 maps the Metro Transit bus and light rail transit system. The figure shows that transit service is limited to the counties at the center of the MSA. Most transit service operates inside Hennepin and Ramsey Counties. Metro Transit operates a combination of local bus service, express bus service, and the Hiawatha corridor light rail transit (LRT) line. At the time of the study, Metro Transit focused a large amount of its service on the Minneapolis CBD. More than 85% of all bus vehicle miles are apportioned to routes that served this CBD. Many bus routes also serve the major centers of the St. Paul CBD and the University of Minnesota. Very few bus routes do not serve one of these major activity centers. Only 7% of all bus vehicle miles are apportioned to routes that do not serve one of these three major activity centers.

Fifteen percent of all bus routes (32 out of 212) serve Hiawatha light rail transit (LRT) line stations. In the CBD, many other bus routes are within walking distance of the LRT. The 12-mile long, 17-station LRT provides relatively frequent all-day service (7–8 minute peak-period service, 10-15 minute off-peak service) in a diagonal corridor that runs from the Mall of America to the Minneapolis CBD. The Hiawatha LRT line opened in 2004 (see Table 82). Metro Transit is currently in the midst of a major bus restructuring, so these statistics will change.

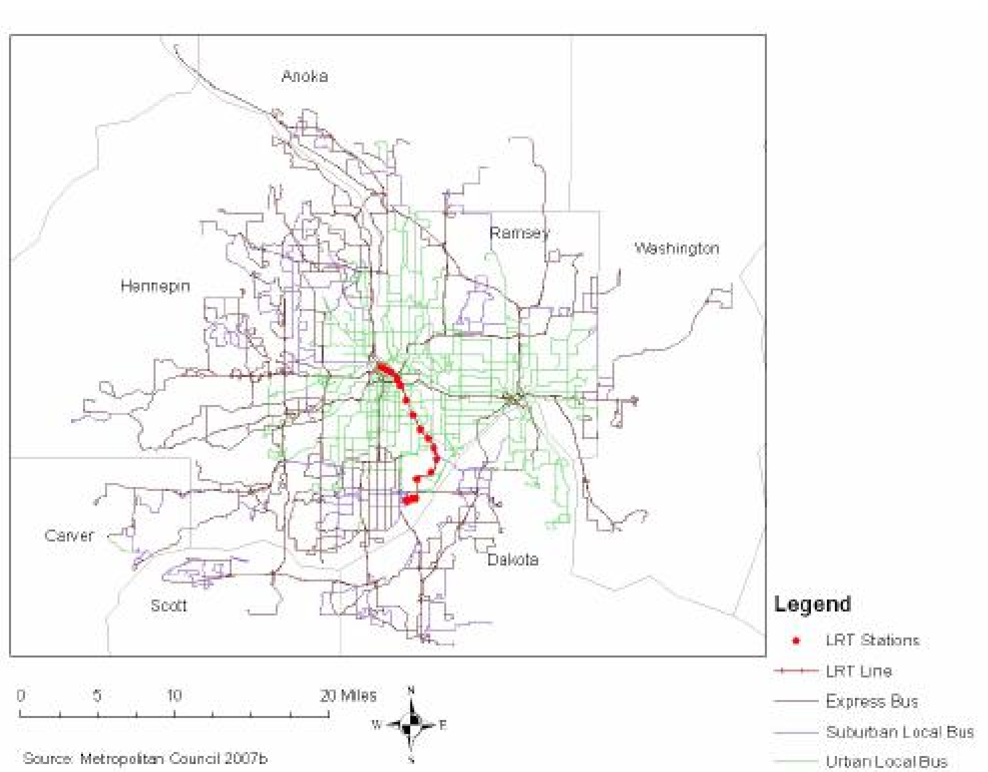


Figure 84 Transit system in the Minneapolis-St. Paul metropolitan area (2007)

Fares

Metro Transit's base adult fare is $1.50 for local service and $2.00 for express service; rush hour fares are $2.00 and $2.75 respectively.[164] Metro Transit provides reduced fares for senior citizens, youths, the disabled, and persons receiving Medicare. Metro Transit also provides a 50-cent downtown fare for trips inside the Minneapolis or St. Paul CBD, but these fares do not grant transfer privileges. Metro Transit also offers a number of multi-hour, daily, and monthly pass options for riders. Transfers are free within a 2.5 hour time window for all patrons except those paying the reduced downtown fare or for patrons transferring from local to express services. Metro Transit also offers special transit pass programs for employers and universities.

Table 82 Minneapolis-St. Paul light rail transit segment openings

Year	Segment Length (miles)	Line	Section	Cumulative System Length (miles)
2004	7.8	Hiawatha Line	Warehouse District/Hennepin Avenue–Fort Snelling	7.8
2004	4.2	Hiawatha Line	Fort Snelling–Mall of America	12.0

Source: Leroy Demery, *U.S. Urban Rail Transit Lines Opened from 1980*, October 18, 2005, 17.
Note: Warehouse District/Hennepin Avenue–Fort Snelling (Phase I) opened June 26, 2004.
Fort Snelling–Mall of America (Phase II) opened December 4, 2004.

Rider Profiles

Metro Transit's marketing department conducted rider surveys of its bus and rail passengers, and these survey results allow researchers to develop a profile for patrons of both service modes.[165] Table 83 provides information about bus riders, while Table 84 presents the same information about rail riders. Comparing the information in the two tables allows the reader to determine that bus patrons are more likely to come from households that own fewer vehicles and have lower household incomes than rail patrons. More than twice as many bus riders as rail riders come from households that do not own a vehicle. More than half of bus patrons come from households that earn less than $40,000 per year versus less than 40% of rail patrons.

Transfer Activity

Nearly half of Minneapolis bus riders, 48%, reported that they had or would be transferring to another bus to complete their trip.[166] Around three-quarters of bus riders who transfer require one bus transfer to complete their trip. Ten percent of bus riders reported that they had transferred from or would be transferring to light-rail to complete their trip.[166] More than 80% of bus riders either agreed or strongly agreed that transferring was not a problem.

While the majority of light-rail riders accessed the train by driving to a park and ride location, more than a quarter of riders (29%) accessed the train through a bus transfer (see Table 85). In addition, 43% of light-rail riders reported that they would be transferring to a bus to complete their trip.[168] Adding the two statistics together results in a 72% transfer rate for LRT trips. Nearly three-quarters of light rail patrons who transfer require only one bus transfer to complete their trip. More than 80% of light-rail rider either agreed or strongly agreed that transferring to a bus was not a problem.[169]

Table 83 Demographics of Metro Transit bus riders

Survey Category	Response	Total Percent
Gender	Male	42
	Female	58
Household vehicles	None	40
	One	32
	Two	21
	Three	5
	Four	1
	Five	1
	Six	1
Income	Under $19,999	28
	$20,000 to $39,999	27
	$40,000 to $59,999	18
	$60,000 to $79,999	11
	$80,000 to $99,999	7
	$100,000 or more	9

Source: Periscope, *Metro Transit Bus Rider Survey: Findings and Recommendations*, Metro Transit of the Minneapolis/St. Paul Metro Area, January 2007, 13–14, 16.

Table 84 Demographics of Metro Transit light rail transit riders

Survey Category	Response	Total Percent
Gender	Male	45
	Female	55
Household vehicles	None	20
	One	39
	Two	32
	Three	8
	Four	1
	Five	0
	Six	0
Income	Under $19,999	16
	$20,000 to $39,999	22
	$40,000 to $59,999	21
	$60,000 to $79,999	15
	$80,000 to $99,999	10
	$100,000 or more	17

Source: Periscope, *Metro Transit Light-Rail Rider Survey: Findings and Recommendations*, Metro Transit of the Minneapolis/St. Paul Metro Area, January 2007, 17–18, 20.

Table 85 Access methods for Metro Transit LRT riders

Method	Total Percent
Drove to park & pide	30
Transferred from bus	29
Walked	24
Drove to other parking	9
Dropped off	4
Rode bicycle	2
Other	3

Source: "Hiawatha Light-Rail: Before and After Update," presented by John Dillery, Metro Transit of Minneapolis-St. Paul, Minnesota, August 2007, 9.

Regional Transit Vision and Its Evolution

This report's interviewees provided a portrait of the regional transit vision in the Twin Cities and its evolution since the time of public takeover of the private transit systems in the early 1970s.[170] Throughout much of this period, the dominant regional vision has been to provide premium, express bus service between suburban areas and the CBD. One of the interviewees qualified his endorsement of this statement by noting that there were other visions looking for new crosstown services and seeking to strengthen specific ridership markets, such as the University of Minnesota. This contact also noted that commuter express routes were not the dominant part of the route ridership studies conducted in the Twin Cities in the 1970s. Still, even this contact acknowledges that express bus service was a dominant vision in the region.

One of the study's interviewees traced the origin of the dominant express bus vision back to the private Twin City Lines, which was interested in taking advantage of the new Interstate freeways (I-35 and I-94) that opened in the late 1960s to provide high-speed service to the CBD. Many express routes that still operate in the Twin Cities are legacies of this earlier period, including a route from the Mall of America to downtown Minneapolis and a route in the Midway area of St. Paul.

With public takeover in the early 1970s, the public transit agency also decided to tap into the express service market by adding services that functioned as overlays on local bus routes. These routes would run local pickup service and then enter the freeways to run as expresses to the CBD. One of the interviewees noted that these services used park and ride facilities in an ad hoc way (spaces at a church or a shopping center, etc) and that the transit agency did not go out of its way to develop park and ride lots. Very little crosstown service was added during the 1970s. The study's interviewees pointed to two crosstown routes (Route 2 Franklin Avenue and Route 80 White Bear Avenue) as having been added during the 1970s and been successful.

Over the past few decades the approach to express bus service has evolved. One of the interviewees contrasted the design of Route 94 (an earlier era express route) with Route 21 (a more recent service). The Route 94 express bus has to depart the freeway at Snelling Avenue to board and alight passengers. This led to delays at the traffic signals, and longer trips for route patrons. Route 21 at Lake Street uses on-freeway stops that are accessed by stairs. Both routes are utilized, although the authors' contact emphasized that the Route 21 approach, with on-freeway stops, is much more desirable, because buses lose less time making the stop.

The study's interviewees felt that express buses performed well at first, but that the express bus strategy has become less successful over time.[171] The mainstays of the express bus network were local pick-up routes that would circulate before entering a freeway to the CBD, as opposed to park-and-ride-based express buses. The pick-up routes tend to offer a limited number of inbound trips during the morning peak and outbound trips during the evening peak, whereas park-and-ride routes tend to offer more service in both directions. One interviewee emphasized that Metro Transit was late in tapping the park-and-ride market, which he characterized as a growing market. More recently, they have developed large park-and-ride lots that are better located and often served by both peak express bus and off-peak local bus service. One of the interviewees observed that shorter-distance express routes perform well, while the longer-distance routes do not perform as well.

In addition to the commuter express routes, the core cities possess local bus routes that correspond to the old streetcar lines. Some of these routes have limited-stop versions that overlay the local service. Over time the local routes have been extended to the inner suburban areas. The outer suburbs felt they were not getting their fair share of service, so they pushed for creation of their own agencies. One interviewee noted that several suburban agencies were created so the suburbs could feel they were being treated fairly and could direct their own services. These operators experimented with local services but their first focus was on providing park-and-ride-based express service to the CBD. Local bus ridership tends to be poor on these suburban systems.

The most successful suburban operator is Minnesota Valley Transit. This operator serves the Mall of America and has bus service that feeds into the LRT. The authors' contact stated that riders do transfer to the LRT. Minnesota Valley Transit accommodates some reverse commute activity, and provides some cross town services.

The region has begun to embrace BRT as part of its express bus-centered vision. One of the interviewees described plans for a combined bus/HOV facility on Interstate 35W that will feature easily accessible on-line stations. Metro Transit presently runs express bus service in this corridor, but these buses lose time because they have to exit the freeway to make stops. One of the interviewees noted that this corridor was originally slated for LRT development but project delays resulted in opening the nearby Hiawatha line. This contact said LRT had been replaced with BRT because people felt it was too close for another LRT line. This contact also acknowledged that the project was a way of getting more throughput from a facility that would be difficult to widen.

The authors' sense is that express bus remains the dominant transit vision in the Twin Cities, although there is new interest in rail development following the opening of the Hiawatha LRT line. However, one of the interviewees noted that Metro Transit views the LRT line in the same way as they do limited-stop buses, the difference being that the LRT has higher speeds and larger passenger capacity. The region is in the process of developing the Northstar commuter rail line to the northern suburbs and a rail connection between Minneapolis and St. Paul. LRT has been extended to meet the commuter rail line. The region is also investigating a bus rapid transit extension of the Hiawatha LRT line to the south, in addition to the I-35W BRT line discussed above.

Regional Transit System Structure and Function

Express services dominate the regional transit vision in Minneapolis, although the actual array of services is becoming more complex. One of the interviewees characterized the transit system as resembling a modified hub and spoke system. The development of the Hiawatha LRT line has prompted some service restructuring. Many express buses terminate at the Mall of America where riders transfer to LRT. However, in many cases buses were continued into the CBD because Metro Transit did not want to force people to transfer. Some of these routes have subsequently been eliminated because of low productivity (indicating that most of their passengers did transfer to LRT). Metro Transit has also added crosstown services, including a trunk line on 46th Street.

The current system-wide restructuring effort has resulted in service changes designed to provide better connections to major activity centers and to LRT. One of the primary focuses of the restructuring is to provide better north-south connectivity in suburban areas where east-west connectivity to the CBD is fairly strong. One of the interviewees noted that a major focus of the restructuring is to simplify the route structure to more of a grid in order to achieve higher service efficiency. This contact felt the preliminary indications of the restructuring effort were positive and strong. This person cited an increase in weekday ridership of 30% in the sector around the Hiawatha LRT line.

The CBD is still a major focus of transit planning. A major piece of transit infrastructure in the Minneapolis CBD is the Nicollet Avenue Mall. While the Mall is widely viewed as having been successful in revitalizing the CBD, there are presently efforts to downplay transit's presence on the mall because of concerns about noise and the particular clientele that uses bus transit. Metro Transit has removed buses from the mall on weekends but not on weekdays. The city has added more capacity on parallel streets so that use of Nicollet Mall and nearby Hennepin Street can be reduced.

Both of the interviewees felt that the Minneapolis CBD was strong but that decentralization was very real and something to which transit had to adapt.[172] As an example of adaptation, one interviewee noted that Metro Transit is now running reverse commute service on their CBD express routes that end at park-and-ride lots, some of which are located near major destinations. This person characterized the resulting ridership on what would have been deadhead runs as modest but real. This contact sees this as a potentially growing market.

Light rail transit (LRT) is obviously an important part of the Metro Transit system. Both of the interviewees pointed to former Governor Jesse Ventura as a key figure in getting light rail built in the Hiawatha Corridor after years of failed plans. LRT had always been a possibility in this corridor and had been part of the Hennepin County Railroad Authority's plan, but opposition derailed its implementation until Ventura championed it.

One interviewee noted that Metro Transit restructured buses at the time of LRT implementation. This contact stated that they located LRT stations at the site of strong crosstown routes and enhanced their service frequency. Metro Transit also restructured to create new crosstown routes (for example, 46th street). This same contact observed that suburban operators have improved frequency on routes to Mall of America. One of the interviewees observed that LRT is carrying more non-work trips than did the earlier bus service it replaced. The commuter trip share is down from 80% to 75%. The Mall of America, CBD, and Minneapolis Airport are important destinations served by LRT. The airport is a particularly important source of ridership, because LRT carries about 4,000 passengers per day between airport terminals.

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

The authors examined riding habit and service productivity at a metropolitan scale. Figure 85 displays riding habit (measured as passenger miles per capita) from 1984 to 2004. The figure shows that transit patronage has not kept pace with population growth and riding habit has fallen 18%. The decline in riding habit appears to be a steady one, with peaks and valleys centered on an overall downward trend. They have no information about major transit events (service changes or fare changes) that might help to explain this pattern. One hypothesis, supported by comments made by the interviewees, is that the graph displays the decreasing effectiveness of Metro Transit's express bus-based service strategy at attracting riders.

Figure 86 displays service productivity (measured as the ratio of passenger miles to vehicle miles, or load factor) over the same period. The figure shows that service productivity has also fallen in the Twin Cities area. The decline in service productivity appears to be a fairly steady one, with peaks and valleys centered on an overall downward trend.

Metro Transit Ridership and Productivity Trends

The authors then examined ridership and productivity within Metro Transit itself. Table 86 reports transit ridership by mode from 1984 to 2004. The table reports ridership on both a passenger mile and unlinked passenger trip basis. The table shows that bus passenger miles have increased slightly over this time period (5%), while bus unlinked passenger trips have declined (12%). (This indicates that the system is carrying fewer passengers traveling longer distances.) Ridership measured in both ways peaked in the late 1990s but fell to 2004. The Hiawatha Light Rail Transit line opened in 2004, so the table reports only one year of data for light rail. One of the interviewees pointed to the loss of population in the inner city, partly attributable to the school system in the area, as a potential explanation for some of the ridership decline. An internal Metro Transit study reports that system ridership (measured as unlinked passenger trips) has increased 3% per year since the LRT opened in 2004.[173]

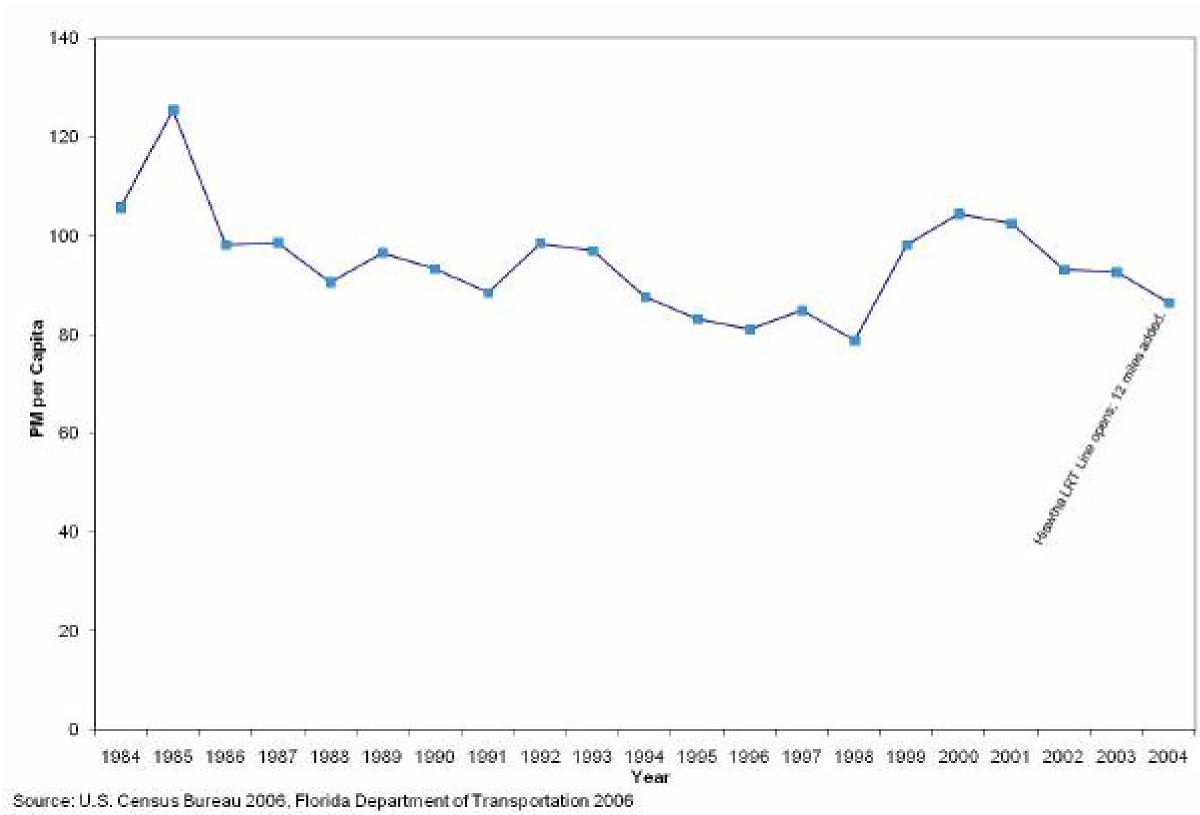


Figure 85 Minneapolis-St. Paul MSA riding habits

Table 87 calculates average trip lengths by mode from the data reported in Table 86. Table 87 shows that average bus trip lengths have increased 25% since 1984. This is perhaps not surprising given Metro Transit's strong emphasis on longer-distance express bus service from the suburbs into the CBD and interviewees' observations that these services have been extended into more distant suburbs in recent years. The average trip length is shorter than expected given Metro transit's strong commuter express bus focus. This suggests that Metro Transit is carrying a lot of short-distance riders on their inner city local bus routes.

Metro Transit service has increased faster than ridership. Table 89 reports vehicle miles by mode from 1984 to 2004. The table indicates that bus vehicle miles have increased nearly 29% over this period. The largest bus service increases occurred prior to 2000; since that time bus vehicle miles have declined slightly.

The result of service increases in excess of ridership gains is declining service productivity, shown in Table 90. An internal Metro Transit report notes an important exception to the productivity decline is combined bus and rail service in the Hiawatha Corridor, where some bus routes have been reconfigured following the introduction of LRT service.[174] Weekday productivity has increased 17%, while weekend productivity has increased nearly 30%. The study's interviewees also noted that the service restructuring currently in progress appears to be generating ridership and productivity gains, although no specific details beyond the Hiawatha Corridor were available.[175]

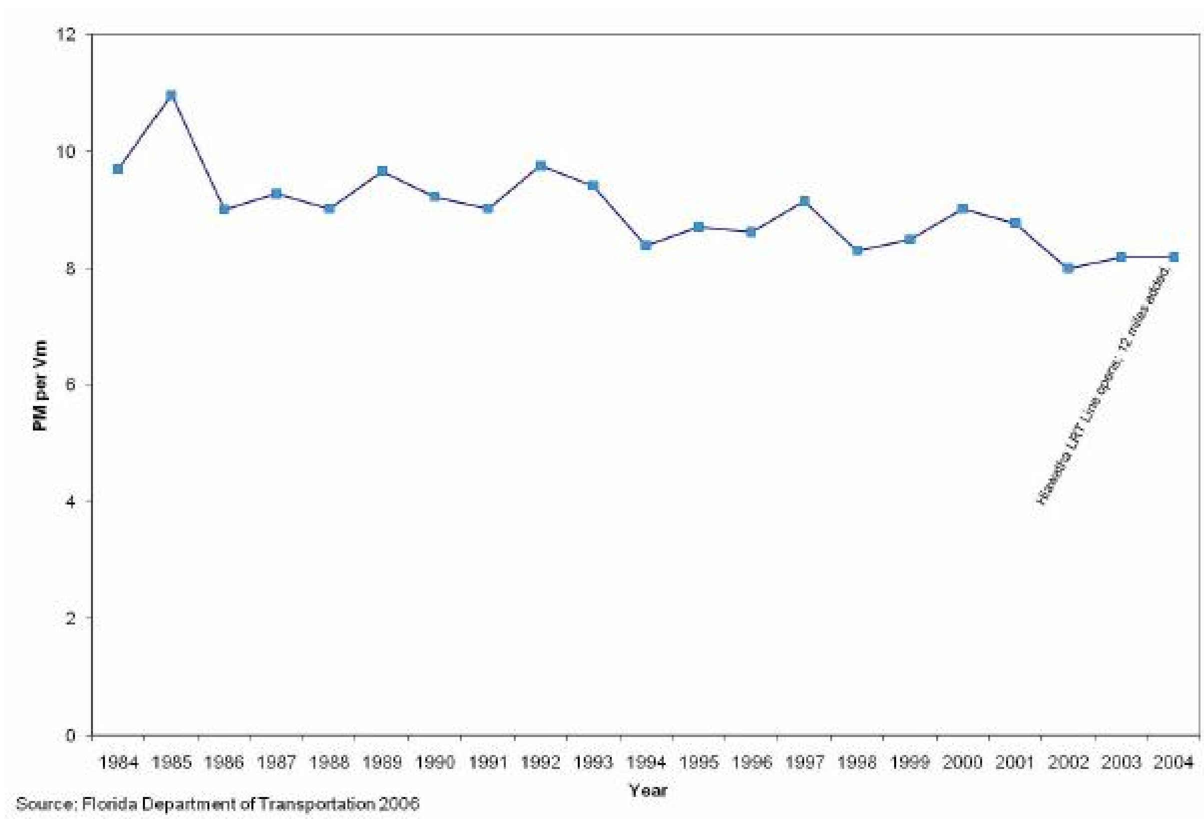


Figure 86 Minneapolis-St. Paul MSA load factor (passenger miles per vehicle mile) (1984-2004)

Metro Transit Bus Route Performance Analysis

The authors also examined transit performance on a route by route basis. The authors obtained data on unlinked passenger trips, vehicle revenue hours, and vehicle revenue miles for average weekday, Saturday, and Sunday service. They used these data to construct two measures of bus route performance: (unlinked passenger) trips per revenue hour and (unlinked passenger) trips per revenue mile. Metro Transit distinguishes between three types of services: urban local bus routes, suburban local bus routes, and express bus routes. They decided to compare the performance of these three types of routes.

Table 86 Ridership on Metro Transit fixed-route transit services (1984–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	Bus	Rail	Total	Bus	Rail	Total
1984	269,612,343		269,612,343	74,455,022		74,455,022
1985	324,824,486		324,824,486	73,581,155		73,581,155
1986	258,115,795		258,115,795	72,729,272		72,729,272
1987	263,396,947		263,396,947	70,806,270		70,806,270
1988	247,595,540		247,595,540	71,272,410		71,272,410
1989	267,800,518		267,800,518	70,839,949		70,839,949
1990	263,284,237		263,284,237	69,588,432		69,588,432
1991	253,507,486		253,507,486	65,376,748		65,376,748
1992	286,341,953		286,341,953	66,303,403		66,303,403
1993	286,812,046		286,812,046	66,598,023		66,598,023
1994	262,923,833		262,923,833	65,562,037		65,562,037
1995	253,215,438		253,215,438	61,109,874		61,109,874
1996	250,367,208		250,367,208	61,905,288		61,905,288
1997	265,870,588		265,870,588	62,065,357		62,065,357
1998	250,695,430		250,695,430	66,048,771		66,048,771
1999	317,284,726		317,284,726	75,838,771		75,838,771
2000	343,129,141		343,129,141	77,726,705		77,726,705
2001	341,547,227		341,547,227	76,750,470		76,750,470
2002	313,679,134		313,679,134	73,243,205		73,243,205
2003	315,012,788		315,012,788	71,327,003		71,327,003
2004	284,441,807	12,120,398	296,562,205	62,392,115	2,938,777	65,330,892

Source: Florida Department of Transportation, 2006.

The authors also distinguished between the routes on the basis of whether they served a CBD or not. Metro Transit defines three major activity centers as CBDs: the Minneapolis CBD, the St. Paul CBD, and the area around the University of Minnesota. They relied on Metro Transit's classification of routes as CBD-serving or non-CBD-serving in this study's analysis. The authors' analysis includes all 207 fixed-route bus routes in the Twin Cities area in operation at the time of an October 2006 service report. Some routes have been changed since that time as part of the service restructuring under way in the region.

Table 90 reports the results of the route performance analysis. The table reports the performance of the median route within each category. The authors focus the discussion on average weekday performance. When trips per revenue hour are used as a measure of performance, one can see that suburban local routes are the strongest performers (as a category), followed by urban local routes, and then express routes. CBD-serving routes outperform their non-CBD-serving counterparts. This last point is not surprising in the case of the suburban local routes given the interviewees' comments that these services were not particularly productive. Indeed, improving these routes (which often have circuitous paths) is a primary objective of the current service restructuring. By contrast, suburban local routes serving the CBD are the strongest of all performers. This is also not surprising since these routes tend to follow relatively straight paths along major arterial roads with large concentrations of activities. The urban local routes outperform their suburban counterparts when trips per revenue mile are used as the measure of route performance.

Table 87 Average trip lengths (Metro Transit) (1984–2004)

Year	Average Trip Length (miles)		
	Bus	Rail	Total
1984	3.62		3.62
1985	4.41		4.41
1986	3.55		3.55
1987	3.72		3.72
1988	3.47		3.47
1989	3.78		3.78
1990	3.78		3.78
1991	3.88		3.88
1992	4.32		4.32
1993	4.31		4.31
1994	4.01		4.01
1995	4.14		4.14
1996	4.04		4.04
1997	4.28		4.28
1998	3.80		3.80
1999	4.18		4.18
2000	4.41		4.41
2001	4.45		4.45
2002	4.28		4.28
2003	4.42		4.42
2004	4.56	4.12	4.54

Source: Florida Department of Transportation, 2006.

The strong performance of most Metro Transit bus route types was somewhat surprising to the authors of this report, given the system's strong CBD-radial characteristics and the relative weakness of the CBDs. A detailed investigation of the variability of route performance revealed very little variability in performance within each route type. Essentially, most bus routes in each route category have similar performance, and there are few truly poor performing routes in the Metro Transit system.

The rather poor showing of the express routes (ranked third as a group on both measures) is not surprising. Given the fact that nearly half the transit routes in the Twin Cities fall into this category, the reader can also begin to understand the relatively low overall service productivity of the area's transit system.

Table 88 Metro Transit fixed-route transit service (1984-2004)

Year	Vehicle Miles		
	Bus	Rail	Total
1984	27,782,168		27,782,168
1985	29,652,895		29,652,895
1986	28,661,522		28,661,522
1987	28,391,249		28,391,249
1988	27,452,302		27,452,302
1989	27,716,307		27,716,307
1990	28,548,553		28,548,553
1991	28,102,551		28,102,551
1992	29,345,827		29,345,827
1993	30,467,748		30,467,748
1994	31,351,477		31,351,477
1995	29,094,009		29,094,009
1996	29,047,570		29,047,570
1997	29,065,384		29,065,384
1998	30,210,893		30,210,893
1999	37,368,055		37,368,055
2000	38,055,087		38,055,087
2001	38,951,160		38,951,160
2002	39,229,791		39,229,791
2003	38,503,175		38,503,175
2004	35,709,393	512,1100	36,221,503

Source: Florida Department of Transportation, 2006.

Table 89 Metro Transit service productivity (1984–2004)

Year	Bus	Rail	Total
1984	9.70		9.70
1985	10.95		10.95
1986	9.01		9.01
1987	9.28		9.28
1988	9.02		9.02
1989	9.66		9.66
1990	9.22		9.22
1991	9.02		9.02
1992	9.76		9.76
1993	9.41		9.41
1994	8.39		8.39
1995	8.70		8.70
1996	8.62		8.62
1997	9.15		9.15
1998	8.30		8.30
1999	8.49		8.49

Table 89 Metro Transit service productivity (1984–2004)

Year	Bus	Rail	Total
2000	9.02		9.02
2001	8.77		8.77
2002	8.00		8.00
2003	8.18		8.18
2004	7.97	23.67	8.19

Source: Florida Department of Transportation, 2006.

Metro Transit Rail Station Entries

The Hiawatha LRT line opened in 2004 and is performing very well. The study's interviewees expressed pleasant surprise at the level of patronage that it is attracting, its high level (and increasing) productivity, and its favorable impact on public opinion toward transit in the area. The authors were able to obtain very limited data about rail patronage from Metro Transit. These data record average weekday LRT boardings by station. Figure 87 maps these data for 2006, the most recent year for which these data were available at the time of data collection. The map shows relatively strong patronage in the Minneapolis CBD, at the two airport stations, and at several stations in between these points that are served by east-west crosstown bus routes. There is also significant boarding activity at the end-of-line Mall of America station.

Table 90 Metro Transit bus route performance

Route Type	Number of Routes	Trips per Revenue Hour (median)			Trips per Revenue Mile (median)		
		Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
All bus routes	207	40.62	33.63	32.38	2.11	1.99	2.09
All bus routes serving the CBD	152	41.05	32.73	31.18	2.15	1.96	2.08
All bus routes not serving the CBD	55	34.15	39.78	41.26	1.51	2.24	2.41
All urban local bus routes	68	40.80	33.63	31.18	2.67	2.05	2.11
Urban local routes serving CBD	57	41.08	32.73	29.97	2.00	2.02	2.09
Urban local routes not serving CBD	11	37.39	39.78	41.26	2.00	2.24	2.41
All suburban local bus routes	46	43.42	62.05	62.58	1.83	3.17	3.16
Suburban local routes serving CBD	7	47.52	62.05	62.58	2.85	3.17	3.16
Suburban local routes not serving CBD	39	13.88	n.a.	n.a.	0.80	n.a.	n.a.
All express bus routes	93	39.66	25.04	27.03	1.77	1.03	1.19
Express routes serving CBD	88	39.66	25.04	27.03	1.77	1.03	1.19

Table 90 Metro Transit bus route performance

Route Type	Number of Routes	Trips per Revenue Hour (median)			Trips per Revenue Mile (median)		
		Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
Express routes not serving CBD	5	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Source: Metro Transit 2006.

Note: The high values reported for Saturday and Sunday are influenced by the much smaller number of routes that provide Saturday and Sunday service.

Emerging and Declining Ridership Markets

The interviewees identified a number of emerging and declining ridership markets in the Twin Cities area.[176] One interviewee pointed to the decline in inner city population and loss of ridership on these services, noted earlier. The interviewees also pointed out the loss of ridership on the express bus services that were not based on park-and-ride lots, also noted earlier. The park-and-ride express bus lines offer service in both directions, unlike the pick-up express bus lines, which offer service in the peak-hour, peak direction. Increasingly, the park-and-ride express bus lines are seeing patronage growth in the reverse direction and during the middle of the day, particularly where the park-and-ride lots are located near major suburban trip attractors, according to one of the interviewees.

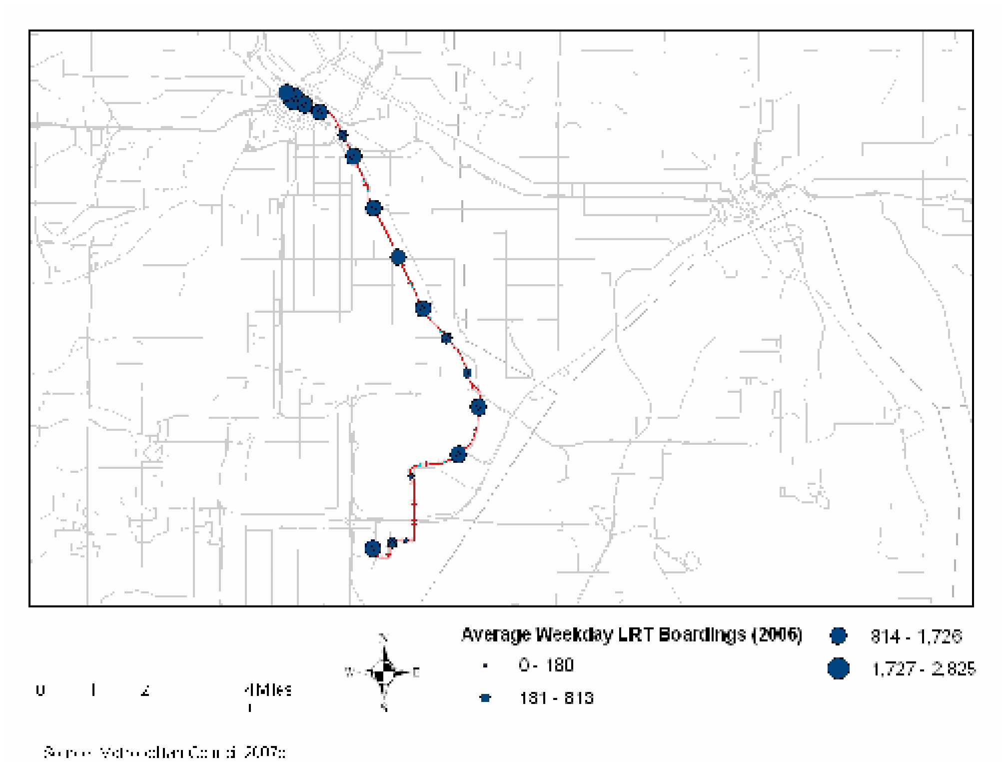


Figure 87 Hiawatha LRT average weekday boardings by station (2006)

This study's interviewees also pointed to a number of emerging markets. Both interviewees emphasized that the CBD was still a strong travel market, but they felt that there was increased demand for service to the west and south of the CBD. Some of this service demand takes the form of demand for reverse commute services while other is demand for more traditional crosstown service. In the case of one strong route (Route 54 running between the St. Paul CBD and the Mall of America), there is demand for both types of service on a single route. One of the interviewees noted that most reverse commute service focuses on particular areas or a particular employer. Sometimes a route runs one trip in the morning and then a return trip in the afternoon or late at night. He also noted that some services provide the return trip late at night. The authors' interpretation is that Metro Transit has taken market segmentation strategies to the point that they are trying to target to serve particular work shifts at particular employers. Whether this is an effective strategy in the long term is highly questionable, given the costs involved in providing these kinds of services.

The interviewees saw potential for more growth in the suburb-to-CBD market if slower services were replaced by faster, more convenient services, such as is planned with BRT in the I-35W corridor. Finally, one interviewee pointed to Metro Transit's employer-based pass program as a success. This contact gave the example of Best Buy's headquarters where the transit mode split is up to 7 to 8%. The Best Buy site is near a park and ride lot served by express bus and is also served by two local crosstown routes.

The light rail line, with its service to major destinations located along it, taps a new market not previously served in the Twin Cities. One of the interviewees was surprised at its success and noted that planners who anticipated that the line would fail made other infrastructure decisions that would make the later extension of the line more costly. Regardless, it appears that there will be extensions of this type of service concept.

Transit and Development

In addition to the role transit, and particularly the Nicollet Avenue Transit Mall, has played in stimulating CBD development, the interviewees point to a development role being played elsewhere, particularly focused on the LRT line. The Twin Cities have actively promoted transit-oriented development around the Hiawatha LRT line. One interviewee pointed to development successes, including a multifamily development at one location, two condominiums at another location, and the refurbishment of a 1960's era shopping center on Lake Street. This contact also emphasized development potential along the southern part of the LRT alignment, including the redevelopment of old warehouses and grain elevators. There is a sense that TOD is a positive contributor to transit ridership, but there have been no formal studies of ridership at these sites.

Public Attitude Toward Transit

The study's interviewees felt that the general public and local policymakers in the Twin Cities are supportive of transit. They attribute the recent intensity of support to LRT's success. State officials (particularly the legislators from suburban and rural areas of the state), on the other hand, are not convinced that transit is important. One example of this is the absence of sufficient dedicated funding for transit to provide high-quality service. Metro Transit's only dedicated funding source is a sales tax on motor vehicles. Another example is the fact that the few BRT transit projects being supported by the state in the Twin Cities are really major highway capacity expansion projects with a very modest transit component.

DISCUSSION

The analysis of transit in the Twin Cities tells a number of different stories. Both regional riding habit and service productivity are in decline in the Twin Cities. On the other hand, bus route productivity, examined on a route type basis, is quite strong, and the bus routes in the Twin Cities outperform their counterparts in the other study cities, such as Atlanta, Portland, and San Diego. The explanation for this seeming disconnect between strong bus route performance and declining overall transit performance is the different roles played by the combined bus and rail services in the various study cities. In many other cities, such as those noted above, the bus routes are part of an integrated bus-rail network. The Twin Cities' bus routes outperform the bus parts of these cities' networks, but their combined bus-rail networks produce much stronger riding habits and service productivity than is seen in the Twin Cities. The authors' sense is that the Hiawatha LRT is such a small part of the regional transit network that transit systems in the Twin Cities do not derive the same network benefits from its presence as do other rail cities from their more substantial rail investments. The Twin Cities obtain network benefits in the Hiawatha corridor, where bus and rail ridership and productivity has increased, but not over the transit system as a whole.

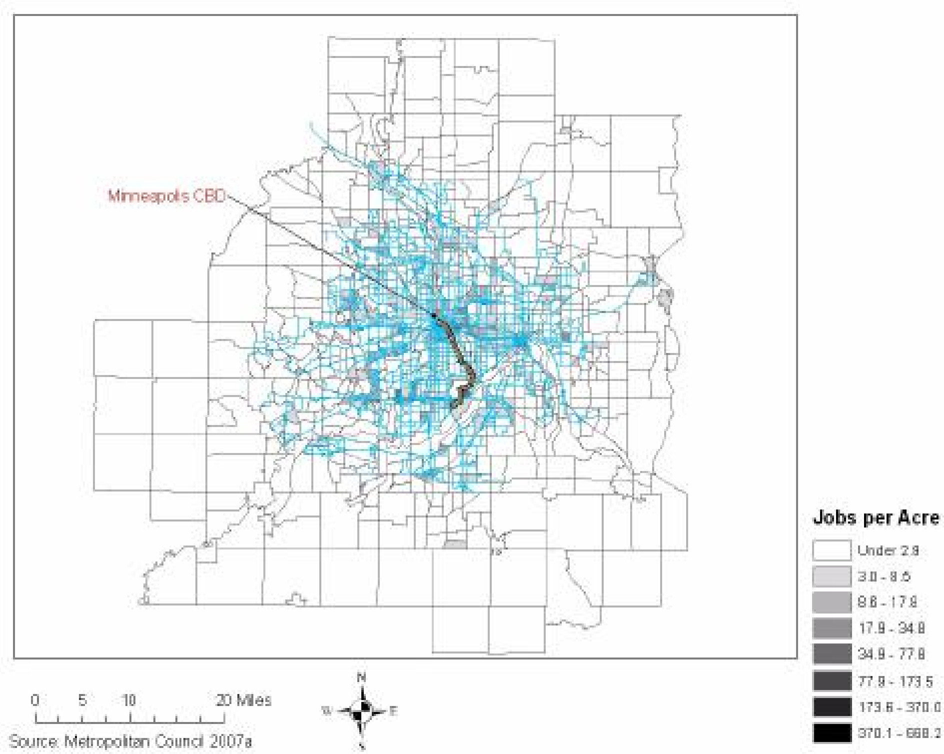


Figure 88 Twin Cities Transit System and its relation to employment (2005)

In the Twin Cities, one can see a progressive region embrace an express bus oriented system and do a good job with it for many years. (Figure 88 shows that Metro Transit provides numerous bus connections from suburban areas to the Minneapolis CBD and inner core of the region. Bus routes are shown in blue and LRT in yellow, overlaid on the employment density map encountered earlier in the case study.) However, despite the strong CBD orientation of the system, the CBDs have been in relative, and in more recent years, absolute decline, and so has the transit system's riding habit and productivity. Light rail was championed not by Metro Transit, but by Hennepin County and the Rail Authority there. After the intervention of Governor Ventura, Metro Transit decided to implement it, but the authors sense that Metro Transit did so somewhat reluctantly. The light rail line, with restructured bus service, represents a new service type for the metropolitan area—a multidestination concept whose success caught Metro Transit off-guard.

The suburban-oriented state government is a major influence on transit policy in the Twin Cities. Its policies favor development of busway facilities within freeway alignments; the authors suspect this is because this enables them to expand freeway capacity.

The authors do not see at this time a coherent regional transit development policy emerging that recognizes the very dispersed and multidestination nature of this far-flung region. There are hopeful signs that such a policy may emerge, perhaps as a result of the current major bus restructuring being undertaken by Metro Transit. But there are also numerous signs that a region-wide perspective is still lacking, most notably in the case of radial commuter rail line development to serve the CBD without taking into account its potential leveraging by connecting bus services or its role in a regional transit network.

APPENDIX F
PITTSBURGH, PENNSYLVANIA

SETTING

The Pittsburgh Metropolitan Statistical Area (MSA) consists of seven counties in southwest Pennsylvania with a total land area of just under 5,300 square miles.[177] With just under 2.4 million persons in 2005, the Pittsburgh MSA ranks as the nation's 21st largest in population. The Pittsburgh MSA's population density is just over 450 persons per square mile.[178]

Two counties represent the center of population and employment in the Pittsburgh MSA: Allegheny and Westmoreland (see Figure 89). The authors refer to these counties as the MSA core counties. The majority of metropolitan transit service and ridership is contained in Allegheny County, which is the service area for Port Authority of Allegheny County Transit (PAT), the metropolitan areas primary transit operator.

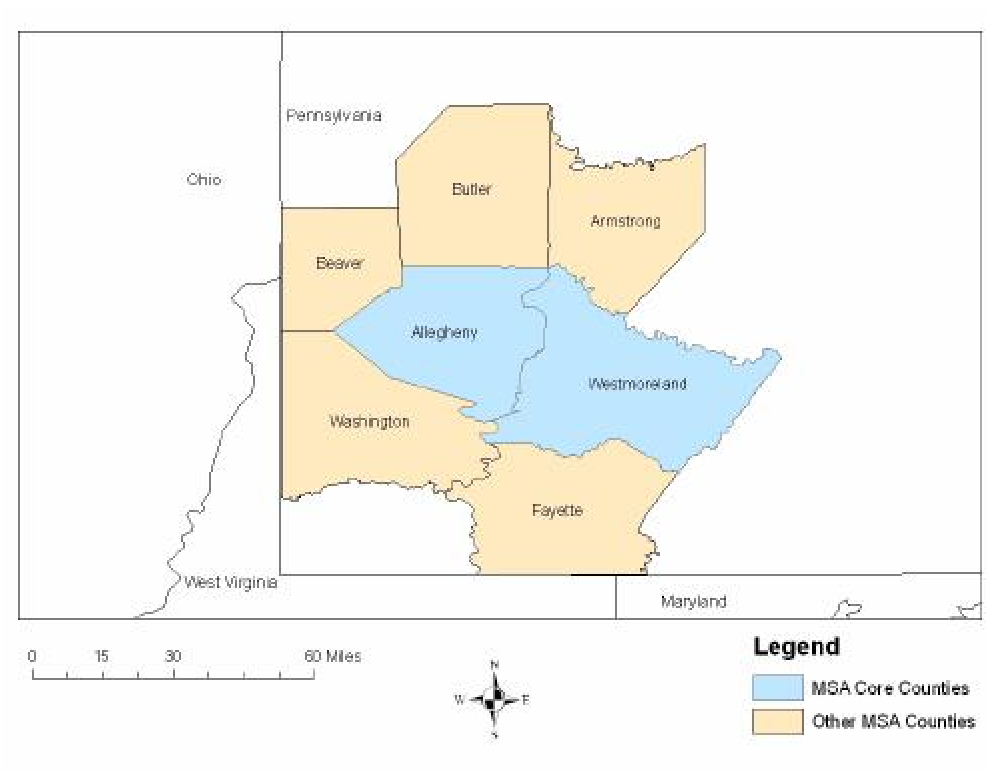


Figure 89 Pittsburgh metropolitan statistical area

Distribution of MSA Population

Pittsburgh is a declining, and increasingly decentralized, metropolitan area. Population has both declined and decentralized considerably since 1970, as shown in Figure 90. This figure provides maps of population by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of population from Allegheny and Westmoreland Counties to the other counties throughout the metropolitan area.

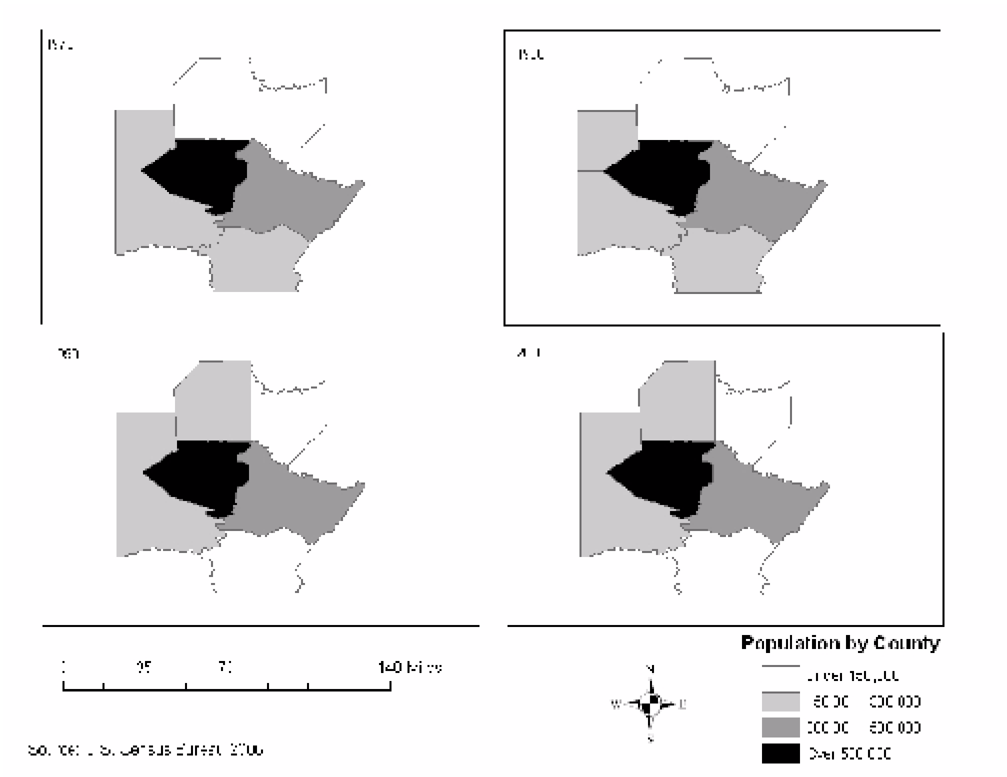


Figure 90 Pittsburgh MSA: population by county (1970-2000)

Between 1970 and 2005, total MSA population declined nearly 14% from 2.8 million to 2.4 million persons (see Table 91). Population has declined in Allegheny and Westmoreland counties (23% and 2%, respectively), while it has increased slightly in the rest of the MSA (1%). In 1970, Allegheny and Westmoreland counties accounted for 72% of the MSA population; today they account for about 67% of the MSA population. Combined, Allegheny and Westmoreland counties have a total land area of 1,756 square miles and an average population density of 1,360 persons per square mile.[179] The remaining five counties occupy 3,500 square miles and have an average population density of 220 persons per square mile.[180]

Figure 91 displays population density inside the Pittsburgh MSA for 2005. The map plots persons per acre by traffic analysis zone (TAZ), using classification categories based on natural breaks in the data. The map indicates that population is widely dispersed throughout the center of the Pittsburgh MSA, with higher population densities in Allegheny County and in corridors that follow the metropolitan area's freeways and other major roads. There are also smaller satellite population clusters that correspond with the cities in the outlying counties.

Table 91 Population in the Pittsburgh metropolitan area (1970–2005)

Year	Allegheny County	Westmoreland County	Other MSA Counties (5 counties)	Total MSA (7 counties)
1970	1,605,133	376,935	777,492	2,759,560
1971	1,593,400	379,800	787,600	2,760,800
1972	1,573,400	382,100	796,400	2,751,900
1973	1,548,900	382,700	798,500	2,730,100
1974	1,525,900	381,900	795,200	2,703,000
1975	1,513,400	385,300	802,000	2,700,700
1976	1,499,400	387,400	807,200	2,694,000
1977	1,486,300	388,200	809,100	2,683,600
1978	1,473,800	389,600	811,500	2,674,900
1979	1,454,300	392,600	812,700	2,659,600
1980	1,450,195	392,184	806,612	2,648,991
1981	1,437,549	391,939	801,224	2,630,712
1982	1,429,717	390,190	800,405	2,620,312
1983	1,420,639	387,822	798,316	2,606,777
1984	1,404,696	385,483	791,768	2,581,947
1985	1,380,315	380,825	781,537	2,542,677
1986	1,366,108	376,936	773,556	2,516,600
1987	1,355,061	373,907	765,869	2,494,837
1988	1,346,483	372,158	761,222	2,479,863
1989	1,339,463	370,411	760,047	2,469,921
1990	1,336,740	370,467	762,474	2,469,681
1991	1,338,435	371,523	767,022	2,476,980
1992	1,340,919	373,857	771,258	2,486,034
1993	1,338,289	375,255	777,405	2,490,949
1994	1,331,772	375,980	779,237	2,486,989
1995	1,322,460	376,188	781,450	2,480,098
1996	1,313,445	375,656	782,108	2,471,209
1997	1,304,196	374,158	781,854	2,460,208
1998	1,295,026	373,060	781,661	2,449,747
1999	1,287,247	371,248	780,023	2,438,518
2000	1,281,666	369,993	779,428	2,431,087
2001	1,272,568	369,109	778,853	2,420,530
2002	1,265,773	368,271	779,549	2,413,593
2003	1,258,476	368,534	781,243	2,408,253
2004	1,247,512	367,937	782,318	2,397,767
2005	1,235,841	367,635	782,598	2,386,074

Source: U.S. Census Bureau, 2006.

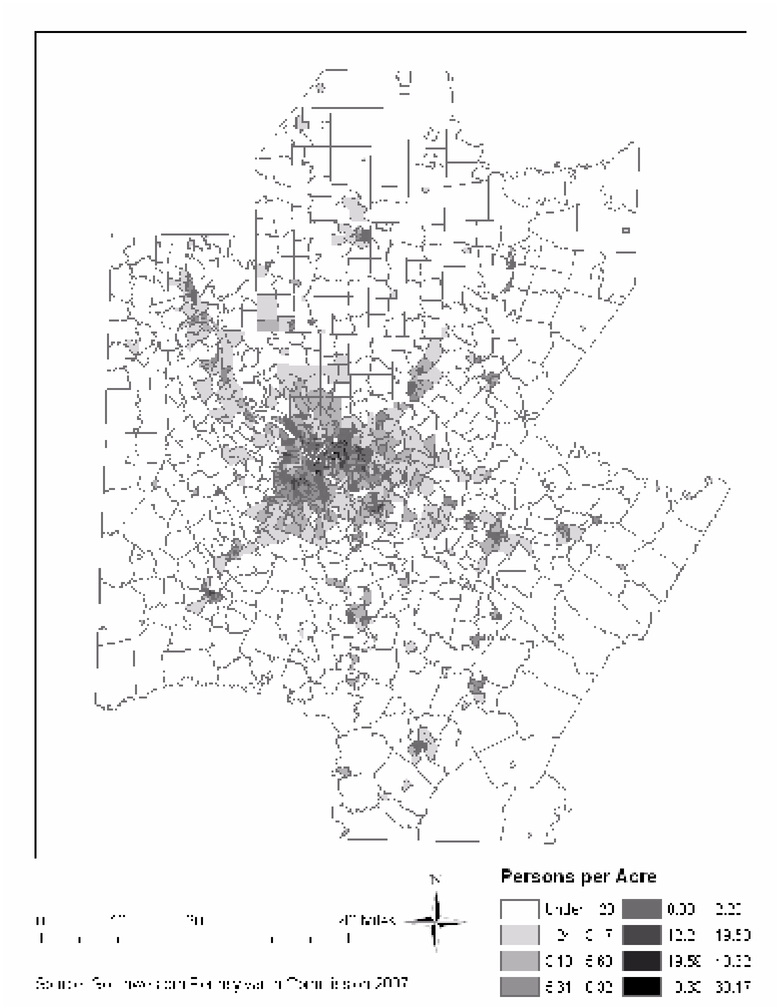


Figure 91 Pittsburgh MSA: population density by transportation analysis zone (2005)

Distribution of MSA Employment

Employment has grown and decentralized over the past several decades, but it remains more concentrated than population. Figure 92 provides maps of employment by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of employment from Allegheny County to Westmoreland County. The maps show very little employment outside these two counties.

Over the past several decades, employment increased a modest 24% as Pittsburgh experienced the loss of many of the manufacturing jobs that had been the foundation for its earlier economic prosperity (see Table 92). Employment growth in Allegheny County has been much slower (16%) than employment growth in Westmoreland County (44%) and the rest of the MSA (37%). In 1970, Allegheny and Westmoreland counties accounted for 77% of all jobs in the MSA; by 2005, they accounted for approximately 74% of all jobs in the MSA. Thus, employment remains concentrated in these two core counties.

Within the Pittsburgh MSA core, employment has also decentralized. The Pittsburgh central business district (CBD) has added jobs since 1970, but most of that employment growth occurred between 1970 and the early 1990s. Pittsburgh CBD employment peaked in 1990 and has declined since that time.

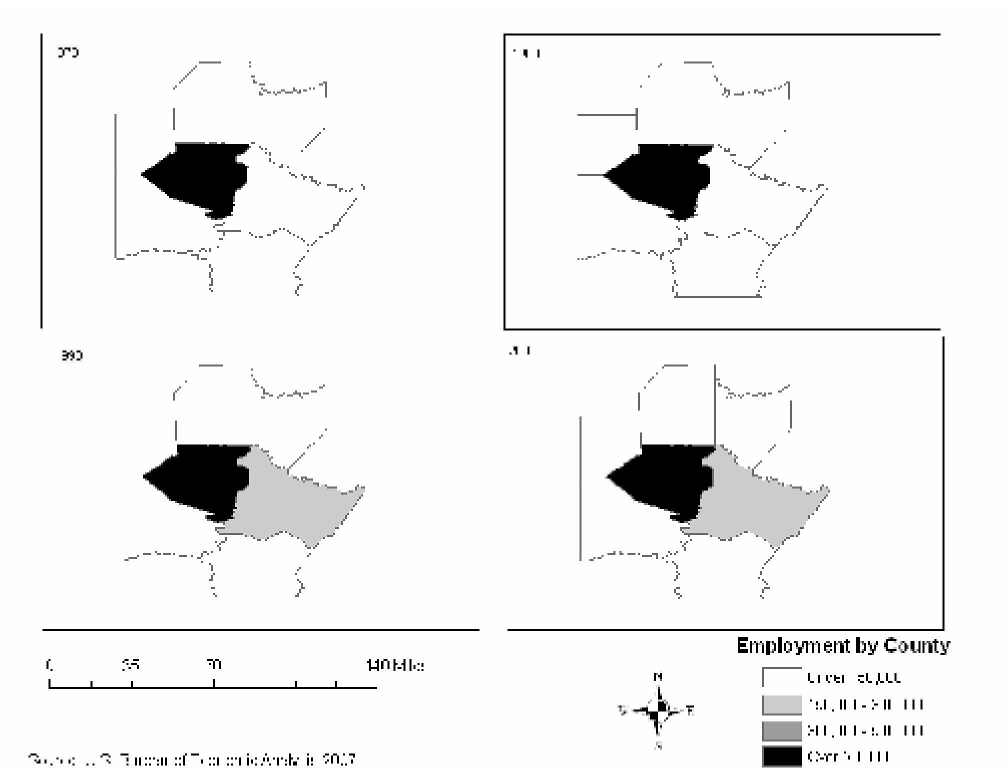


Figure 92 Pittsburgh MSA: employment by county (1970–2000)

Table 92 Employment in the Pittsburgh metropolitan area (1970–2005)

Year	Allegheny County			Westmoreland County	Other MSA Counties (5 counties)	Total MSA (7 counties)
	Pittsburgh CBD	Outside Pittsburgh CBD	Total			
1970	68,800	671,988	740,788	125,286	266,285	1,132,359
1971	71,201	655,132	726,333	124,495	262,985	1,113,813
1972	73,686	655,036	728,722	127,869	267,437	1,124,028
1973	76,258	667,163	743,421	132,484	278,206	1,154,111
1974	78,919	670,287	749,206	134,866	282,968	1,167,040
1975	81,673	659,709	741,382	133,951	284,616	1,159,949
1976	84,524	661,108	745,632	137,049	287,300	1,169,981
1977	87,474	665,195	752,669	140,518	292,311	1,185,498
1978	90,526	677,267	767,793	145,880	296,292	1,209,965
1979	93,686	685,250	778,936	150,936	302,799	1,232,671
1980	97,000	676,155	773,155	149,649	293,755	1,216,559
1981	98,649	669,801	768,450	148,550	288,298	1,205,298

Table 92 Employment in the Pittsburgh metropolitan area (1970–2005)

Year	Allegheny County			Westmoreland County	Other MSA Counties (5 counties)	Total MSA (7 counties)
	Pittsburgh CBD	Outside Pittsburgh CBD	Total			
1982	100,326	648,369	748,695	142,135	270,223	1,161,053
1983	102,032	626,718	728,750	139,430	257,637	1,125,817
1984	103,766	630,905	734,671	141,369	263,211	1,139,251
1985	105,530	639,141	744,671	143,490	263,888	1,152,049
1986	107,324	639,009	746,333	144,375	266,734	1,157,442
1987	109,149	652,302	761,451	148,802	274,625	1,184,878
1988	111,004	673,663	784,667	151,544	280,387	1,216,598
1989	112,891	687,401	800,292	152,442	286,303	1,239,037
1990	114,814	705,054	819,868	155,270	293,352	1,268,490
1991	112,724	699,670	812,394	155,019	292,942	1,260,355
1992	110,673	706,095	816,768	156,629	295,962	1,269,359
1993	108,659	710,904	819,563	157,955	299,641	1,277,159
1994	106,681	716,319	823,000	161,310	308,128	1,292,438
1995	104,739	721,131	825,870	165,768	314,875	1,306,513
1996	102,833	723,709	826,542	167,664	319,894	1,314,100
1997	100,962	732,309	833,271	172,458	324,257	1,329,986
1998	99,124	746,707	845,831	169,692	330,170	1,345,693
1999	97,320	763,105	860,425	171,607	336,646	1,368,678
2000	95,550	779,734	875,284	174,257	344,938	1,394,479
2001	94,671	786,291	880,962	173,056	348,886	1,402,904
2002	93,800	776,889	870,689	173,449	351,074	1,395,212
2003	92,937	770,347	863,284	172,097	353,043	1,388,424
2004	92,082	769,786	861,868	176,007	358,508	1,396,383
2005	91,235	770,374	861,609	181,313	364,694	1,407,616

Sources: U.S. Bureau of Economic Analysis 2007; U.S. Census Bureau 1970, 1980, 1990, 2000.

Figure 93 maps employment density in the Pittsburgh MSA for 2005, the most recent year for which detailed employment data are available. The map displays jobs per acre by traffic analysis zone (TAZ), using classification categories based on natural breaks in the data. The map indicates that while employment is dispersed, it is much more concentrated than population. The map shows that while the Pittsburgh CBD and the nearby Oakland area contain major employment clusters, there are also additional clusters scattered around the core of the metropolitan area. These clusters appear to be located nearby major roads and highways. There are also smaller employment clusters in the outer cities that correspond to the population clusters discussed earlier.

The Pittsburgh MSA emerges from this brief examination of population and employment growth and distribution as a relatively stagnant, decentralized metropolitan area. Both population and employment are decentralized, but there are a number of employment clusters and/or employment-rich corridors, shown in Figure 93. This pattern of potential travel destinations has clear implications for the structure of the transit systems in the region. The pattern suggests a decentralized regional transit system with a series of major focal points, one of which is the Pittsburgh CBD. The authors discuss the Pittsburgh area's transit system later in the case study.

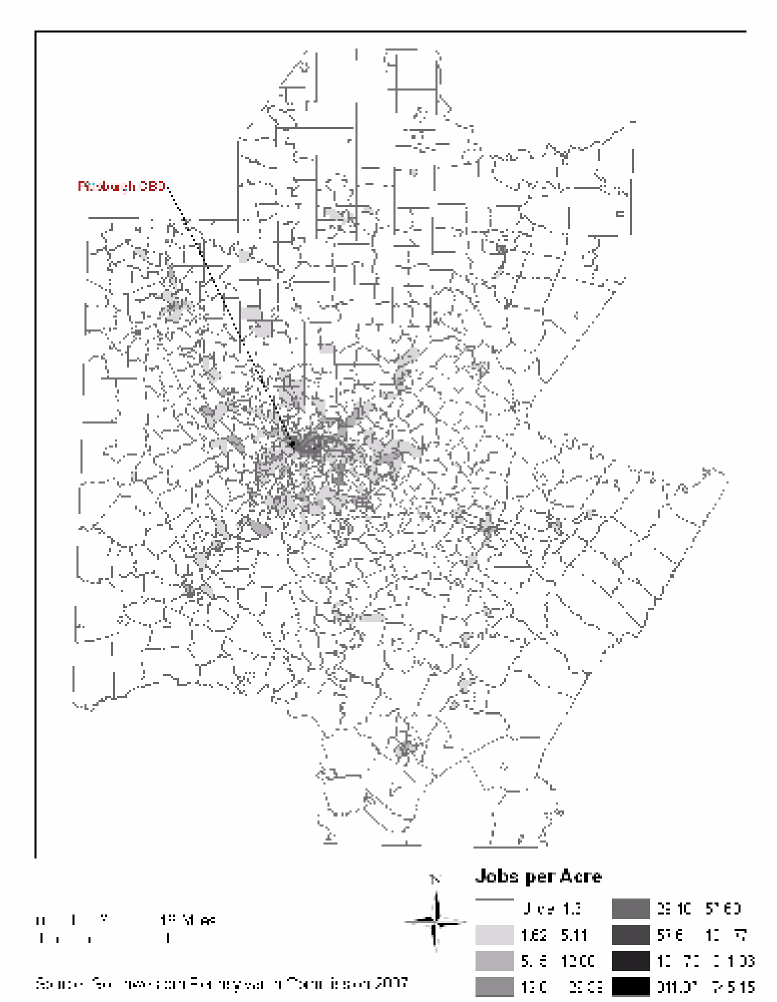


Figure 93 Pittsburgh MSA: employment density by transportation analysis zone (2005)

Institutions and Key Actors

A number of public and private entities play roles in transit planning and policymaking in the Pittsburgh area. The key public entities include Port Authority of Allegheny County Transit, the Southwestern Pennsylvania Commission, and the Allegheny County government (and particularly the County Chief Executive). The private sectors entities include the Heinz Endowment and local business organizations.

Port Authority of Allegheny County Transit (PAT)

Port Authority of Allegheny County Transit (PAT) is the primary public transit agency in the Pittsburgh area. PAT operates fixed-route and demand-responsive bus service and light rail transit service in Allegheny County. PAT is governed by a nine-member board whose members are appointed by the Allegheny County Chief Executive with the approval of the Allegheny County Council. PAT is presently coping with a major funding shortfall, and has cut back its service.

Southwestern Pennsylvania Commission

Southwestern Pennsylvania Commission (SPC) is the metropolitan planning organization (MPO) for the 10-county Pittsburgh region. The SPC approves the short-range Transportation Improvement Program (TIP) and Long Range Transportation Plan (LRTP) required for federal aid. SPC is governed by an appointed board whose voting members include elected officials from the City of Pittsburgh and each of the 10 counties, and non-voting representatives of Federal Highway Administration, Federal Transit Administration, Federal Aviation Administration, U.S. Environmental Protection Agency, U.S. Economic Development Administration, and the office of the Governor of Pennsylvania.

Allegheny County

Allegheny County plays an important role in transit policy by virtue of the County Chief Executive's power to appoint members of the PAT board and the County Council's role in approving these appointments and through the county's representation on the MPO board. The position of County Chief Executive is a recent creation. One of the interviewees characterized the first person in that position as not being active in transit issues. According to these same contacts, the present County Chief Executive played a more direct role in selecting PAT's director and has been in favor of the agency's sizeable service cuts (15% service cut, with a potential additional 10% service cut) implemented to address its present funding shortfall.

Heinz Endowment and Other Private Actors

The Heinz Endowment, a local philanthropy, has funded several regional transit studies in the Pittsburgh area. One of this study's interviewees singled out Mr. Maxwell King in particular as being very active in initiatives that are intended to make the Pittsburgh area more economically competitive and improve the quality of life of its residents. Other private sector entities, including the Allegheny Conference on Community Development, have also played important roles at various points in the region's transit history.

Transit Agencies, Modes, Fares, and Rider Profiles

A number of transit agencies provide fixed-route service in the Pittsburgh metropolitan area. Four of these agencies provide at least some service in Allegheny County, at the core of the metropolitan area (see Figure 94). The focus of this study is the Port Authority of Allegheny

County Transit (PAT). However, the authors briefly discuss three smaller operators in the text below.

Small Transit Agency Services, Fares, and Ridership

Three small transit agencies, based in the suburban counties surrounding Allegheny County, provide service into Pittsburgh. These agencies are: Beaver County Transit Authority (BCTA), GG and C Bus Company, Inc. (GGC), and Westmoreland County Transit Authority (WCTA). Combined, these three agencies carried 850,000 riders more than 9.8 million passenger miles in 2004 (see Table 93 and Table 94). They accounted for less than 3% of the total MSA transit ridership in that year.

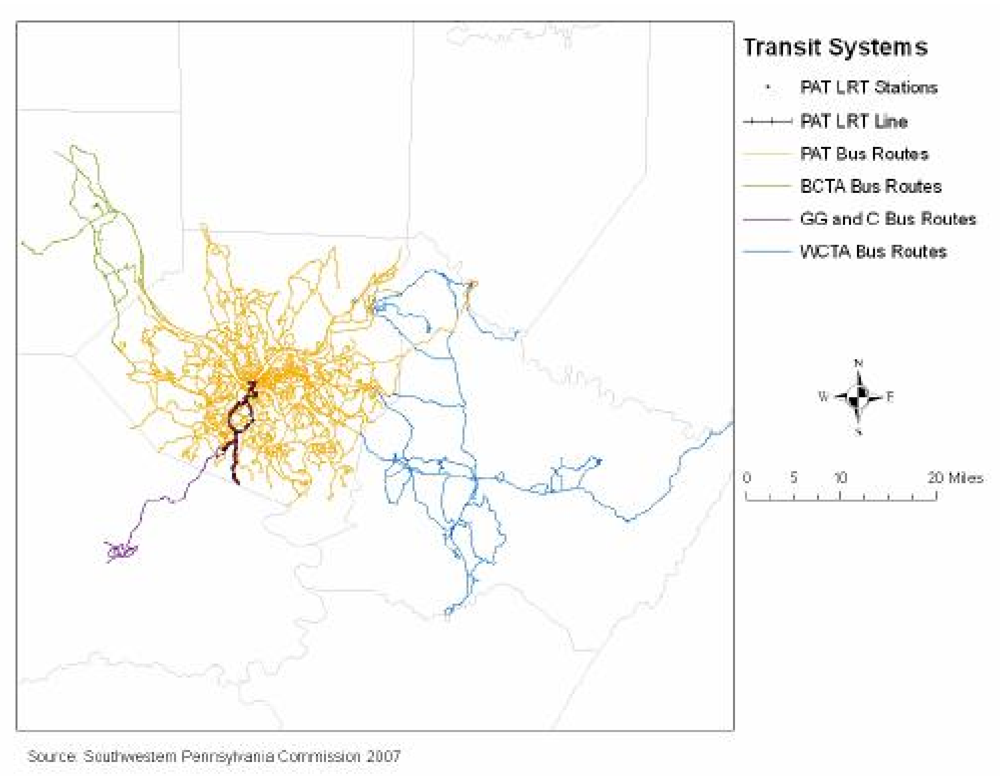


Figure 94 Transit systems in the Pittsburgh metropolitan area (2007)

Beaver County Transit Authority (BCTA) is the largest of the three smaller operators in terms of passengers carried. Table 93 and Table 94 show that BCTA has experienced steadily increasing ridership over the past several years. BCTA operates seven regular-service routes, four of which provide service from Beaver County into Pittsburgh. BCTA has a differential fare system based on the number of fare zones through which a traveler rides. BCTA has a two-zone fare system. The standard adult fare is $1.75 per single-zone ride.[181] BCTA provides discounted fares for children and the elderly. BCTA also sells single-day, multi-day, multi-ride, and monthly passes. Transfers are free across BCTA routes. BCTA riders also have free transfer privileges to a limited set of PAT bus routes.

GG and C Bus Company (GGC) is the smallest of the three smaller operators in terms of passengers carried. GGC operates fixed-route and specialty services from Washington County. Table 93 and Table 94 report that GGC has experienced declining ridership; this appears to us to be largely a consequence of substantially reduced service. GGC operates limited local fixed-route service in Washington County, and provides commuter service to Pittsburgh. GGC local bus fares are $1.10 per ride, while commuter fares range from $1.50 to $5.00 per ride depending on distance traveled.[182] GGC provides discounted fares for children, senior citizens, and the disabled. GGC sells multi-trip ride books at a slight per-ride discount. GGC has no published policy regarding transfers.

Table 93 Transit ridership (UPT) on smaller Pittsburgh systems (1984–2004)

Year	Beaver County Transit Authority	G G & C Bus Company, Inc.	Westmoreland County Transit Authority
1984	305,076	177,352	153,471
1985	660,426	176,501	154,074
1986	351,890	129,443	139,682
1987	397,696	122,277	139,805
1988	438,872	131,757	189,773
1989	444,708	123,700	211,005
1990	426,812	237,736	211,075
1991	452,196	237,710	218,133
1992	454,628	237,732	226,316
1993	465,840	151,572	244,074
1994	458,549	151,572	225,394
1995	466,287	151,572	225,394
1996	433,983	82,120	225,261
1997	427,007	75,848	218,262
1998	393,327	71,461	209,686
1999	399,962	62,332	188,754
2000	405,653	62,354	294,551
2001	417,441	51,921	307,302
2002	417,829	47,834	288,441
2003	472,698	44,012	283,733
2004	532,945	40,164	276,608

Source: Florida Department of Transportation, 2006.

Table 94 Transit ridership (passenger miles) on smaller Pittsburgh systems (1984–2004)

Year	Beaver County Transit Authority	G G & C Bus Company, Inc.	Westmoreland County Transit Authority
1984	5,112,290	1,046,117	
1985	11,062,135	1,046,117	1,818,073
1986	5,894,157	507,661	1,564,438
1987	6,661,536	461,670	1,649,699
1988	7,351,132	437,767	1,844,146

Table 94 Transit ridership (passenger miles) on smaller Pittsburgh systems (1984–2004)

Year	Beaver County Transit Authority	G G & C Bus Company, Inc.	Westmoreland County Transit Authority
1989	7,448,808	499,067	1,840,067
1990	7,155,362	1,432,388	1,822,224
1991	7,574,309	1,408,275	1,954,596
1992	9,261,381	1,432,448	2,038,557
1993	9,507,332	1,408,275	1,962,815
1994	9,351,072	1,408,275	1,813,882
1995	9,501,441	1,408,275	1,813,882
1996	8,825,780	574,667	1,960,713
1997	8,605,412	523,314	2,023,996
1998	5,342,983	499,537	1,824,268
1999	5,086,473	371,176	1,763,754
2000	5,161,845	371,186	3,211,279
2001	5,337,838	306,318	2,833,868
2002	5,353,244	320,943	3,001,315
2003	5,371,276	295,262	2,942,311
2004	6,031,108	269,408	3,510,156

Source: Florida Department of Transportation, 2006.

Westmoreland County Transit Authority (WCTA) is the third of the smaller transit agencies. WCTA provides local bus service in Westmoreland County and express bus service between Westmoreland County and Pittsburgh. Table 93 andTable 94 report that WCTA has experienced steadily increasing ridership since the mid-1980s. WCTA local adult bus fares are $1.20 per ride, with a 30 cent surcharge for each additional zone through which a traveler passes. Commuter (express) fares start at $2.00 per ride WCTA has a total of six zones in its fare system. WCTA provides discounted fares for children, senior citizens, and the disabled. WCTA sells multi-trip passes at a modest per-ride discount. WCTA provides free transfers within a specific fare zone. WCTA riders in the New Kensington area may transfer to PAT buses for a $.25 transfer charge.

PAT Services and Fares

Port Authority of Allegheny County Transit (PAT) operates a combination of fixed-route bus service, light rail transit, and demand-responsive bus service in Allegheny County. Figure 94 shows the location of PAT fixed-route bus and LRT services. The map indicates that a sizeable proportion of PAT routes are focused on the Pittsburgh CBD, the triangle at the center of the map. PAT has identified the Pittsburgh CBD as a particularly important travel market. Out of a total of 213 PAT bus routes, 174 serve the Pittsburgh CBD. These routes account for 84.6% of weekday bus service. PAT's three busways and LRT line also serve the Pittsburgh CBD.

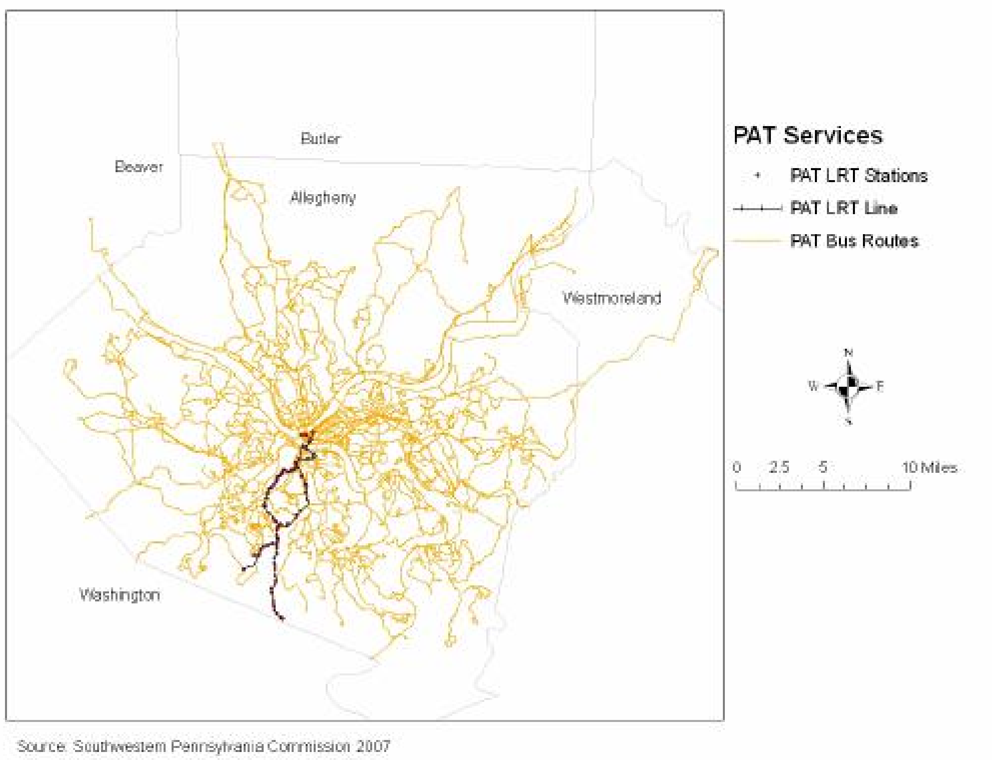


Figure 95 PAT Transit System

Pittsburgh's three busways are shown in the map of PAT transit services in the center of Pittsburgh (see Figure 96). The oldest of the three busways is the South (South Hills) Busway, which opened in 1977. The East, or Martin Luther King Jr., Busway opened in 1983. The West Busway opened in 2000. Pittsburgh's LRT system dates to the early 20th century, although it was reconstructed in the 1980s (see Table 95).

While this study does not focus on demand-responsive services, it is important to briefly note the service in Pittsburgh. PAT's demand-responsive service, ACCESS Dial-a-Ride, is a very large system and, according to the interviewees, carries the largest ridership of any demand-responsive service in the country. ACCESS is essentially a contract operation with local taxi operators. One of the interviewees reports that the operating cost per passenger ($2.48 per passenger mile) is very high. These facts pose serious financial challenges to PAT. PAT has been cutting back on fixed-route service because of a financial shortfall.

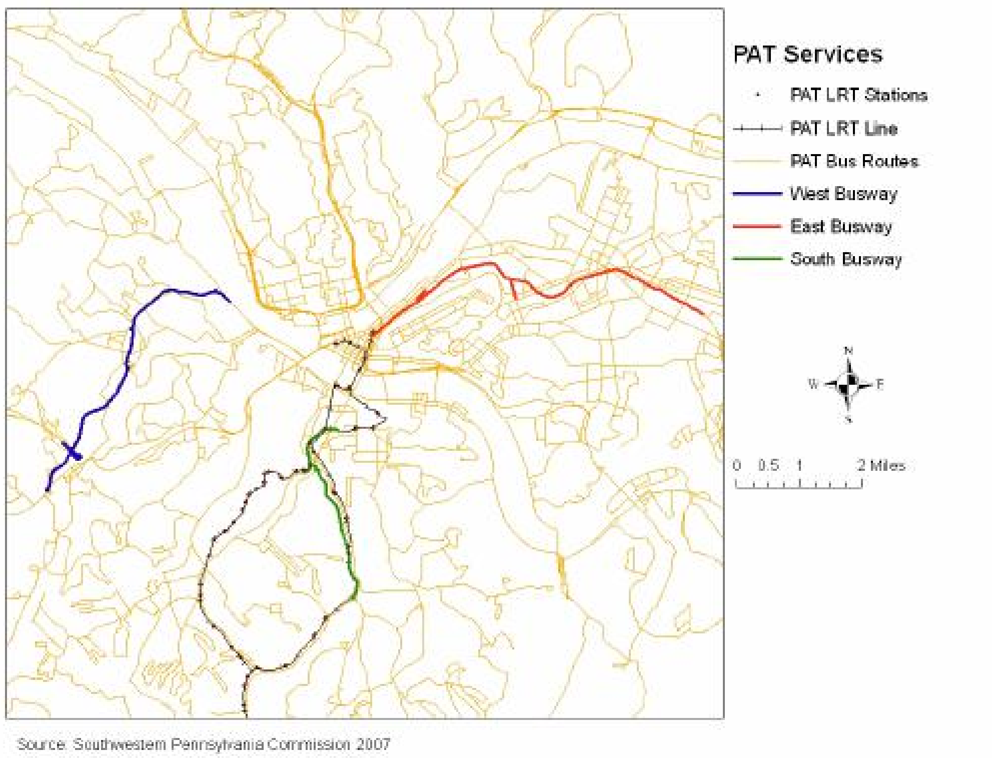


Figure 96 PAT Transit Services in central Pittsburgh (2007)

PAT has a three zone-based fare system.[183] Downtown Pittsburgh itself is a free-fare zone. The area immediately adjacent to downtown is called the downtowner zone. Single-ride downtowner bus fares are $1.25; passengers pay an additional 50 cents for each zone they cross up to a maximum of a $2.75 fare. Peak-period LRT users pay a surcharge of 25 cents in the downtown zone and $.50 for travel outside the downtown zone. Children, the disabled, and individuals receiving Medicare pay discounted fares. Senior citizens ride free. PAT also sells multi-ride tickets and weekly, monthly, and annual transit passes. Transfers are 50 cents for adults (half that price for groups that are eligible for discounted fares) and are valid for three hours. One interviewee reported that PAT is considering simplifying their fare system by abolishing its zones and moving to a flat fare. The result would be higher fares for short-distance riders, and lower fares for long-distance riders.

PAT Ridership Profile

The interviewees characterized PAT's ridership profile.[184] One contact reported that most transit trips are for work, with school trips ranked second. This same contact reports that many CBD-bound riders are choice riders, who select transit because of road congestion and high CBD parking charges ($14 per day and higher). LRT riders tend to have higher incomes than either busway riders or local bus riders. Local bus riders are a largely transit-dependent population. One contact pointed to the fact that rail runs through higher income communities as a possible explanation for the difference in rider incomes.

Table 95 Pittsburgh light rail transit segment openings since 1984

Year	Segment Length (miles)	Line	Section
1984	**+2.1	South Hills Village	Castle Shannon–Washington Junction–Dorchester
	+0.5		Dorchester–South Hills Village
1985	+0.5	Subway	Gateway Center–Steel Plaza
	+0.9	Panhandle Tunnel and Bridge	Station Square–Steel Plaza
1986	*-2.5	52–Allentown	Panhandle Bridge–South Hills Junction
1987	**+5.4	Dormont Line	South Hills Junction–Castle Shannon
1988	+0.4	Penn Station Branch	Steel Plaza–Penn Station
1993	**+2.5	52–Allentown	Panhandle Bridge–South Hills Junction
	*-5.5	Overbrook Line	South Hills Junction–Overbrook –Castle Shannon
1999	*-1.2	Drake Branch	Dorchester–Drake
2004	**+5.5	Overbrook Line	South Hills Junction–Overbrook –Castle Shannon

Source: Leroy Demery, *U.S. Urban Rail Transit Lines Opened from 1980*, October 18, 2005, 22,23.
Notes: *operation suspended. ** operation restored following reconstruction.
Overbrook line reconstruction started 2000, line reopened June 2, 2004.
Most of the Pittsburgh LRT system was upgraded from segments opened prior to formal inauguration of "LRT" service on July 3, 1985.

ANALYSIS

Regional Transit Vision and Its Evolution

The study's interviewees provided us with an overview of the history of transit development in the Pittsburgh area, including a discussion of the metropolitan area's transit vision and the evolution of that vision.[185] An important objective of transit development has been to retain the Pittsburgh CBD's primacy as a major business center; during the 1940s and 1950s, the Pittsburgh CBD was second only to Manhattan as a major business center in the United States. The emphasis on serving the CBD continues to this day.

One of the interviewees noted that Pittsburgh Railways, the privately-owned predecessor to PAT, was a profitable, private business up until the time of public takeover in 1963. They operated a 75-route, largely radial streetcar system focused on the Pittsburgh CBD. A handful of their routes served the mills and factories of East Pittsburgh, and connected these locations to the Pittsburgh CBD. Pittsburgh Railways also ran 12 bus routes under the Pittsburgh Motor Coach moniker. These bus routes were also focused on the CBD. Pittsburgh also had a commuter rail system that was eliminated in 1963 due to the efforts of the Allegheny County Conference on Community Development, which one of the interviewees said was allied to Gulf Oil and Bethlehem Steel. In 1963, Port Authority of Allegheny County acquired the private streetcars and motor buses, and over the next 13 years replaced most of the streetcars with bus service. They retained the streetcars running to the south, which operated on private rights-of-way. These streetcars were eventually converted into the South Hills LRT line.

One of the interviewees described the debates in the mid-to-late 1960s about regional transit in Pittsburgh. Around 1967, PAT conducted a study of county-wide rapid transit. PAT debated implementing the fixed-guideway skybus technology, but hesitated from doing so because of the cost involved. PAT developed its downtown subway to remove streetcars from the local streets. During the early 1970s, the MPO (now SPC) conducted a series of studies outlining an extensive regional rapid transit system, similar to that of BART in San Francisco. These plans did not lead to any action. During the late 1970s, Pittsburgh opened its South Hills Busway and began construction of the LRT line. The later busways followed in the early 1980s (East Busway) and in 2000 (West Busway).

Bus plays the primary role in transit in the Pittsburgh area and is the focus of the regional transit vision. One of the study's interviewees pointed to the likely future development of new busways as well as on-street bus rapid transit inside Allegheny County and regionally throughout the MSA. This same contact pointed to some expansion of LRT, including via the North Shore Connector (under construction) that links the CBD to the Carnegie Science Center and two sports stadia, and may eventually reach the Pittsburgh airport. Both interviewees characterized the primary role of bus and rail as being to bring people into the Pittsburgh CBD.

Regional Transit System Structure and Function

The transit system in Pittsburgh is a radial one, with a primary focus on the Pittsburgh CBD. In outlying areas, the buses radiate into major hubs and connect to county seats, using a timed-transfer approach. One of the interviewees pointed to the street network (with arterials oriented to serving the urban core) and topographic conditions as important explanations for the system's orientation. According to one interviewee, topographic conditions also explain the duplication of service in the PAT bus system. This contact pointed to the example of a bus route running on a bluff and a parallel route operating below it. However, this same contact also noted that PAT will occasionally offer parallel local and express bus services.

The study's interviewees characterized the PAT system as being in transition. One of the interviewees observed that they have changed some routes that used to run to the CBD into feeder routes. This same person observed that the public has historically tended to oppose such changes, because they object to transfers, but that public has accepted recent conversions as being better than the complete loss of service in an environment of service cutbacks. PAT eliminated 30 bus routes in June, and reduced service on numerous others. PAT recently converted many routes in the South Hills area into feeders, but they do not yet have data on the performance of these routes. PAT's policy of charging for transfers makes the successful (from a patronage perspective) restructuring of lines into feeders much more difficult. PAT is about to undertake a Transit Development Plan (TDP) to evaluate their entire transit system.

The busways are important elements in the PAT system. They were originally developed to enable more efficient service into the CBD, although one interviewee claimed these efficiencies have never materialized. Busway-serving routes tend to fan from the suburbs onto the busways and head into the CBD and then back out. The busways are exclusive bus-only facilities with on-line stations. The east busway serves the CBD and the Oakland area (three miles to the east). East busway patrons tend to be minorities. Most routes operating on the east busway are commuter-oriented routes with a strong peaking of patronage. However, the east busway also has a dedicated route running back and forth that has good ridership (13,000 per day) throughout the day in both travel directions. The interviewees noted that this was very different from the other two busways.

The south busway travels through a largely residential area, and carries a middle class ridership. Many people access its service from park and ride lots. One interviewee characterized the south busway as having declining patronage. The west busway parallels a freeway and runs between the CBD and the western suburbs. The area is largely residential, although transit-oriented development is being examined near the Carnegie station. The west busway was intended to connect to the airport and planned to carry 50,000 riders per day, but cost overruns led to its truncation. The line carries about 9,000 riders per day, with ridership trending downward. One route using the west busway serves the Robinson Town Center, a major regional shopping mall. At the CBD end of the west busway, patrons are let off near the Gateway subway station from whence they can transfer free and access many downtown destinations. One interviewee characterized the west busway clientele as a working class ridership.

LRT is a small part of the PAT system. One interviewee said that LRT behaves like a commuter rail system, although this contact also noted some riders are using it as a circulator to reach destinations across the river from the CBD. The LRT line runs through a more developed residential area, and there is a major shopping mall (South Hills Village) at the southern end of the line. The line is utilized, although one contact felt that PAT was not using it as effectively as it could. This contact pointed to the fact that a sizeable number of bus routes run to the CBD when they might have been restructured as rail feeders. PAT has recently restructured several bus lines as rail feeders, but it has retained its policy of charging an additional fee for transfers.

The interviewees felt that the various transit agencies in the Pittsburgh metropolitan area still operate independently of one another. One contact characterized regional cooperation as a work in progress that is being developed through a transit operators committee created by the SPC. Recent infrastructure investments downtown (including a parking garage near the Greyhound Terminal) have become settings where multiple operators board and alight passengers, and could be serves as sites for between-agency transfer activity.

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

The authors examined regional riding habit and service productivity trends in Pittsburgh between 1984 and 2004 and related these measures of transit performance to service or fare policies that might be expected to influence these measures. Figure 97 shows riding habit (measures as passenger miles per capita) from 1984 to 2004. Over this period, riding habit has declined among Pittsburgh metropolitan area residents, although there have been riding habit spikes relating to the opening (or re-opening) of different rail or busway segments and the introduction of the university transit pass program and transfer privileges for BCTA and WCTA riders. One of the interviewees cautioned us that ridership numbers for Pittsburgh may not be reliable because of PAT's fare policies. PAT has a free downtown subway and collects fares differently on low-level passenger platforms (on the vehicle) and high-level passenger platforms (on the platform)

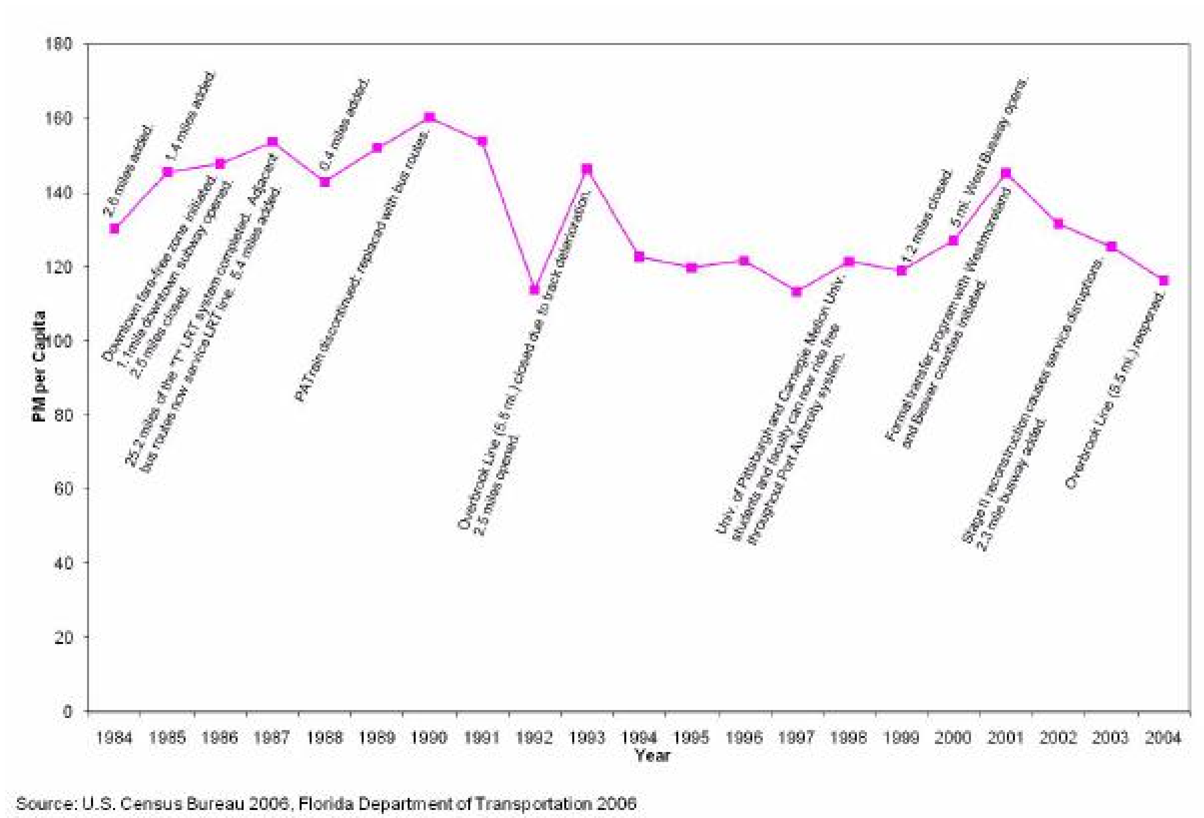
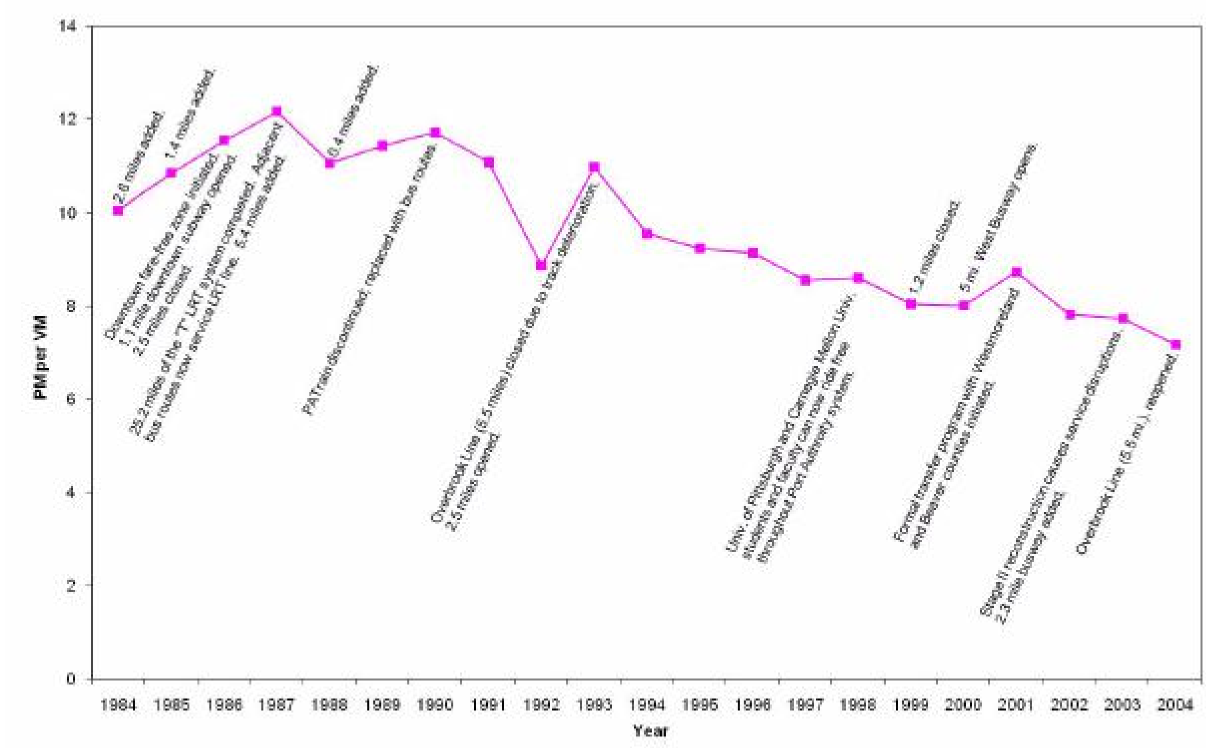


Figure 97 Pittsburgh MSA riding habit (passenger miles per capita) (1984-2004)

Figure 98 reports service productivity (measured as passenger miles per vehicle mile, or load factor) trends over the same period, and again relates the trend to important events. The trend is toward deteriorating service productivity over the period. Modest productivity improvements in the earlier part of the trend occurred at the same time as service extensions to

LRT or the creation of the free fare zone downtown. More recently, the productivity changes have been less spiked and more closely follow a gradual downward trend.



Source: Florida Department of Transportation 2006

Figure 98 Pittsburgh MSA load factor (passenger miles per vehicle mile) (1984–2004)

PAT System Ridership and Productivity Trends

PAT has experienced declining ridership (on both an unlinked passenger trip and passenger mile basis) since 1984 (see Table 96). Bus patronage has declined by approximately 25% over this period. Rail patronage has increased more than 60% since 1984, but it is down from its early 1990s ridership peak. Changes in passenger miles are smaller than the changes in unlinked passenger trips, thus indicating a slight increase in average trip lengths. Table 97 shows that average trips lengths for bus and rail patrons have increased slightly.

PAT added service between 1984 and 2004, although it is cutting service at the present time (see Table 98). Bus service increased approximately 10%, while rail service increased approximately 50% between 1984 and 2004. Table 99 reports service productivity (measured as passenger miles per vehicle mile, or load factor) by mode. Given the combination of declining ridership and increased service, the downward trend in bus service productivity (in particular) is not surprising. Rail service productivity increased from 1984 to 2004, but has declined from an earlier service productivity peak.

Table 96 Ridership on PAT fixed route transit services (1984–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	PAT Bus	PAT Rail	PAT Total	Pat Bus	Pat Rail	PAT Total
1984	327,270,440	16,703,996	343,974,436	83,444,509	4,131,439	87,575,948
1985	355,236,985	15,471,747	370,708,732	83,645,125	2,526,592	86,171,717
1986	353,368,125	25,125,833	378,493,958	82,079,313	6,040,659	88,119,972
1987	361,008,027	28,499,668	389,507,695	79,068,544	5,397,548	84,466,092
1988	307,116,376	51,395,931	358,512,307	77,415,662	8,184,514	85,600,176
1989	316,720,976	63,503,321	380,224,297	76,914,419	9,044,143	85,958,562
1990	346,428,510	54,368,675	400,797,185	75,297,743	9,890,037	85,187,780
1991	323,406,843	61,553,483	384,960,326	73,573,385	9,986,585	83,559,970
1992	231,758,185	49,487,510	281,245,695	65,632,509	8,727,762	74,360,271
1993	325,783,062	40,164,408	365,947,470	67,330,743	8,837,078	76,167,821
1994	268,764,618	35,758,200	304,522,818	64,811,124	7,943,343	72,754,467
1995	255,051,951	41,001,165	296,053,116	64,357,300	7,996,139	72,353,439
1996	261,562,127	39,505,835	301,067,962	64,107,305	7,380,596	71,487,901
1997	239,424,525	39,328,044	278,752,569	63,583,194	7,420,704	71,003,898
1998	265,563,747	35,764,028	301,327,775	64,646,890	7,591,553	72,238,443
1999	261,764,795	32,573,606	294,338,401	65,916,191	7,343,766	73,259,957
2000	279,219,902	33,216,196	312,436,098	66,553,980	7,358,650	73,912,630
2001	324,030,752	32,837,137	356,867,889	66,022,059	7,513,701	73,535,760
2002	288,614,562	32,937,455	321,552,017	65,056,626	7,483,030	72,539,656
2003	273,194,946	31,987,571	305,182,517	59,988,122	7,157,772	67,145,894
2004	250,052,887	30,025,476	280,078,363	58,297,773	6,654,554	64,952,327

Source: Florida Department of Transportation, 2006.

Table 97 Average trip lengths (PAT) (1984–2004)

Year	Average Trip Lengths (miles)		
	PAT Bus	PAT Rail	PAT Total
1984	3.92	4.04	3.93
1985	4.25	6.12	4.30
1986	4.31	4.16	4.30
1987	4.57	5.28	4.61
1988	3.97	6.28	4.19
1989	4.12	7.02	4.42
1990	4.60	5.50	4.70
1991	4.40	6.16	4.61
1992	3.53	5.67	3.78
1993	4.84	4.54	4.80
1994	4.15	4.50	4.19
1995	3.96	5.13	4.09
1996	4.08	5.35	4.21

Table 97 Average trip lengths (PAT) (1984–2004)

Year	Average Trip Lengths (miles)		
	PAT Bus	PAT Rail	PAT Total
1997	3.77	5.30	3.93
1998	4.11	4.71	4.17
1999	3.97	4.44	4.02
2000	4.20	4.51	4.23
2001	4.91	4.37	4.85
2002	4.44	4.40	4.43
2003	4.55	4.47	4.55
2004	4.29	4.51	4.31

Source: Florida Department of Transportation, 2006.

Table 98 PAT fixed route transit service (1984–2004)

Year	Vehicle Miles		
	PAT Bus	PAT Rail	PAT Total
1984	32,751,622	1,029,324	33,780,946
1985	32,668,946	1,098,082	33,767,028
1986	31,058,100	1,343,334	32,401,434
1987	30,261,430	1,435,983	31,697,413
1988	29,895,616	2,252,118	32,147,734
1989	30,871,506	2,078,942	32,950,448
1990	31,508,125	2,222,426	33,730,551
1991	32,057,956	2,295,909	34,353,865
1992	29,723,084	2,049,336	31,772,420
1993	30,962,476	2,155,420	33,117,896
1994	30,077,753	1,712,557	31,790,310
1995	30,488,382	1,680,071	32,168,453
1996	31,237,315	1,711,638	32,948,953
1997	30,836,785	1,782,071	32,618,856
1998	32,783,659	1,854,251	34,637,910
1999	34,369,723	1,851,175	36,220,898
2000	36,422,988	1,893,842	38,316,830
2001	38,203,081	1,718,370	39,921,451
2002	38,568,888	1,674,686	40,243,574
2003	36,745,177	1,520,763	38,265,940
2004	36,570,069	1,509,202	38,079,271

Source: Florida Department of Transportation 2006.

Table 99 PAT service productivity (1984–2004)

Year	PAT Bus	PAT Rail	PAT Total
1984	9.99	16.23	10.18
1985	10.87	14.09	10.98
1986	11.38	18.70	11.68
1987	11.93	19.85	12.29
1988	10.27	22.82	11.15
1989	10.26	30.55	11.54
1990	10.99	24.46	11.88
1991	10.09	26.81	11.21
1992	7.80	24.15	8.85
1993	10.52	18.63	11.05
1994	8.94	20.88	9.58
1995	8.37	24.40	9.20
1996	8.37	23.08	9.14
1997	7.76	22.07	8.55
1998	8.10	19.29	8.70
1999	7.62	17.60	8.13
2000	7.67	17.54	8.15
2001	8.48	19.11	8.94
2002	7.48	19.67	7.99
2003	7.43	21.03	7.98
2004	6.84	19.89	7.36

Source: Florida Department of Transportation 2006.

Bus Route Performance Analysis

The authors obtained route-based ridership and service statistics for Port Authority of Allegheny County's bus services for 2006. These data included: unlinked passenger trips (or boardings), vehicle revenue hours, and vehicle revenue miles for the average weekday, Saturday, and Sunday. Using these data, they calculated two performance statistics for each bus route: (unlinked passenger) trips per revenue hour and (unlinked passenger) trips per revenue mile. To evaluate the performance of the various routes, they then classified the bus routes on the basis of whether they do or do not serve the Pittsburgh CBD, and the route type (using Port Authority's classification scheme). per capita then use the performance of the median bus route in each route group to represent the performance of the entire group. Pittsburgh has a very CBD-focused transit system. Out of 213 bus routes, only 39 routes do not serve the Pittsburgh CBD.

Table 100 presents the results of the bus route performance analysis. The table shows that Pittsburgh's bus routes are not very strong performers. The median bus route in each route group in Pittsburgh has much weaker performance than its counterpart in other case study cities such as Atlanta, Dallas, and Denver. Among the classes of routes, the CBD-serving routes outperform their non-CBD counterparts. For weekday service, the CBD local routes are the strongest performers, followed by the CBD express routes, and the non-CBD local routes. The poorest performing routes are the feeder routes. One possible explanation for the poor performance of these routes is Port Authority's policy of charging additional fares for riders seeking to transfer. This policy adds an additional disincentive to making transfers from one route to another, and thus undercuts the performance of the feeder routes.

Table 100 PAT bus route performance

Route Type	Number of Routes	Trips per Revenue Hour (median)			Trips per Revenue Mile (median)		
		Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
All routes	213	18.98	17.19	15.93	1.31	1.29	1.23
All non-CBD routes	39	13.20	9.17	11.56	0.99	0.87	1.15
Non-CBD local routes	20	18.15	8.71	14.33	1.37	0.82	1.18
Non-CBD feeder routes	19	9.95	9.41	7.90	0.80	0.91	1.13
All CBD routes	174	19.97	19.75	18.56	1.35	1.49	1.30
CBD local routes	98	21.89	20.10	18.63	1.58	1.56	1.34
CBD express routes	72	18.22	16.35	13.19	1.08	1.10	0.85
CBD feeder routes	4	13.51	13.70	10.78	1.15	1.44	1.14

Source: Calculated from Port Authority of Allegheny County Transit, 2006.

Emerging and Declining Ridership Markets

The study's interviewees pointed to emerging and declining ridership markets in Pittsburgh. One interviewee pointed to the growing residential and employment to the west as an emerging market for transit. Serving this growth area was part of the original rationale for the west busway, and transit operators have added service to major destinations in this area, including the Robinson Town Center which functions as a transit service focal point. One contact sees the airport, Robinson Town center, and park and ride serving commuters from Carnegie as important ridership generators in this part of the metropolitan area.

The interviewees discussed two other types of services that many transit agencies are using to tap new ridership markets: through route services (where previously disconnected routes are connected into a single route) and reverse commute services. Pittsburgh has tried using through routes in some corridors, and presently has the route 500 through route and the route 100 through route on the west busway. One contact reported that ridership on route 500 has not been as high as expected, but that circuitous routing and/or a lack of public awareness about the service may explain this result. Route 100 has good peak-period ridership, but much smaller off-peak and evening ridership. PAT operated another through route, 501, but discontinued it.

Pittsburgh has experienced declining ridership overall, so targeting a single market (or even a set of markets) as a declining one may or may not be revelatory. One contact, however, singled out senior citizens as a declining ridership market, despite the fact that they ride free. (Senior rides are paid from state lottery funds.) This contact noted that today's seniors are part of a generation that grew up using a car. They have never been regular transit users. Their predecessors tended to be people who grew up without cars and/or were regular transit users.

Transit and Development

Pittsburgh has begun to focus on a closer link between transit and development in its current regional transit visioning exercises. Transit-oriented development (TOD) has emerged as a major component in this visioning process. One interviewee reported that the visioning process produced a TOD toolbox, PowerPoint presentation, and brochure that local governments and developers use. The other interviewee was quite skeptical of the growth scenarios that have emerged from the visioning process.

The MPO, the city of Pittsburgh, and Allegheny County have each adopted a transit-supportive land use strategy in their own plans. The state of Pennsylvania has also been supportive of transit-supportive land use strategies. In 2004, the state Legislature created Transit Revitalization Investment Districts (TRID) that function like tax increment financing districts. The use value created by transit investment is returned to the community or the transit system. TRID is being studied in two communities (Dormont, Mount Lebanon) in the southern part of Allegheny County.

There is very limited TOD in place in Pittsburgh. One interviewee pointed to the region's weak real estate market as a barrier to development around stations. On the east busway, there is a lot of development, but it has occurred ad hoc. One interviewee noted that some of this development does, however, have TOD characteristics. This same contact pointed to discussions about TOD in the south hills area and at Carnegie.

Contemporary Challenges

The most immediate challenge confronting transit in Pittsburgh, and PAT in particular, is the transit funding crisis. PAT has a sizeable deficit that it is attempting to cover through service cuts and fare increases. To date, service has only been cut 15%, and the public has been involved through a public hearing process. An additional 10% service cut is contingent on Allegheny County coming up with a local match to a newly approved (in July) dedicated state funding source for transit agencies. They are looking at taxes on alcohol and rental cars for the local match, not local sales taxes. The state had been providing funding for transit, but it was never dedicated before and it was stagnant in the face of escalating costs. There is no dedicated regional transit funding mechanism, and state legislation would be required to institute such a mechanism.

DISCUSSION

Demand for transit service in Pittsburgh has been declining throughout the period of this study. In part the decline is caused by the decline of the region, which during this time has lost population and decentralized at the same time. The authors do not think this is the entire reason for Pittsburgh's transit decline, however. St. Louis, for example, is another declining industrial region that is stagnant in population growth while also decentralizing. Transit in St. Louis, however, has rebounded and grown in riding habit and productivity since it made its light rail investment.

In Pittsburgh the authors believe the other part of the explanation for transit decline results from the transit system's (PAT) focus on serving the CBD, whose absolute and relative importance to the region (after bucking national trends in the 1980s and 1990s) has declined significantly since 2001 (see Figure 99 which overlays the PAT transit system on the map of employment density shown earlier). PAT has achieved tremendous success in capturing a large (50%) share of the CBD commute travel market; unfortunately this is a declining travel market. PAT has not achieved success in taking transit patrons to other destinations outside the central core, a record standing in stark contrast to that of most other metropolitan areas that they studied.

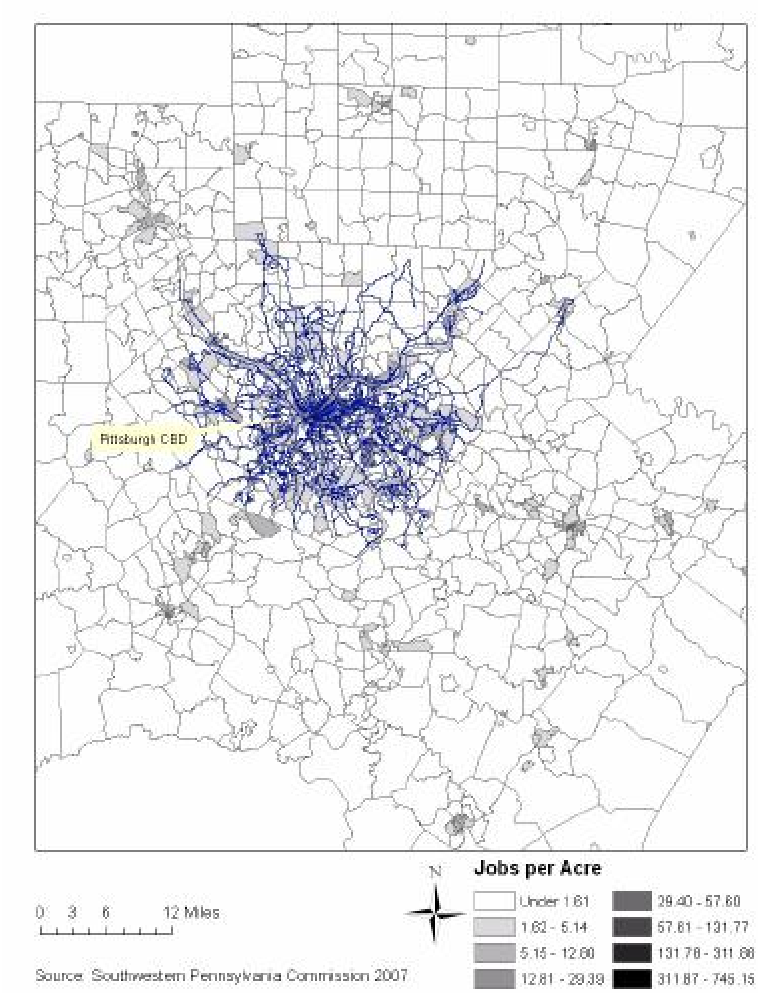


Figure 99 PAT Transit System and its relation to employment (2005)

Since the 1970s, Pittsburgh has invested heavily in three busways focused on providing rapid peak-hour bus service from commuter neighborhoods into downtown Pittsburgh. These major transit investments have done little to facilitate transit travel to other transit destinations in the region, however, and little such travel has materialized. This lack of facilitation stands in stark contrast to, for example, Atlanta's (MARTA) rapid transit investments which, while also centered on Atlanta's CBD, also enabled the restructuring of the bus transit system to reach suburban destinations. As a consequence, the growth of suburban Atlanta jobs that are served by this system translate into growing suburban transit patronage which makes use of both the rail line and the bus lines that are integrated together into a single network. This suburban-oriented demand keeps Atlanta's transit productivity high whereas the growth of suburban jobs in Pittsburgh fails to stimulate transit demand.

Pittsburgh's rail investments have been confined to one corridor and, while substantial, they stand in contrast to those just referenced in Atlanta. They also stand in contrast to the just-opened line of comparable magnitude in Minneapolis where the rail investments were used as part of a strategy of creating multidestination transit in its sector of the region, to great success in both riding habit and overall transit productivity in the corridor.

In Pittsburgh, the rail lines are treated as just another radial transit service to the CBD, which happens to be on tracks rather than on the road. The LRT line is isolated in a CBD-radial network. On its own, it has pretty good ridership and productivity. But there is no attempt to make use of this major investment to reach more destinations or improve transit system ridership or system productivity, which is poor due to the very poor performance of PAT's bus routes.

This difference in LRT treatment and use in part results from the fact that the light rail line is a conversion of the last streetcar corridor in the region, whose abandonment was prevented by citizen activists. It is therefore not located optimally to make it a backbone of a regional transit system serving several important destinations, around which bus lines could be reconfigured, such as in St. Louis, Atlanta, San Diego, Portland or Minneapolis. Nonetheless, the LRT line has at its southern terminus a major suburban destination, the South Hills Mall, just as the Hiawatha LRT line in Minneapolis has at its southern terminus the Mall of America. The transit system in Minneapolis has used its LRT investment, which has numerous similarities to Pittsburgh's, to successfully reconfigure its bus service. Reconfiguration of bus lines to take advantage of the large investment that Pittsburgh has made in its rail line might also bring major benefits. The possibility should at least be investigated. PAT is about to undertake a review of its entire system, in which these points might be considered.

APPENDIX G
PORTLAND, OREGON

SETTING

The Portland Metropolitan Statistical Area (MSA) consists of seven counties in northwest Oregon and southwest Washington with a total land area of just under 6,700 square miles.[186] With just under 2.1 million persons in 2005, the Portland MSA ranks as the nation's 24th largest in population.[187] The Portland MSA's population density is just over 310 persons per square mile.

Four counties represent the center of population and employment in the Portland MSA: Clackamas, Multnomah, and Washington Counties in Oregon and Clark County in Washington (see Figure 100). The authors refer to these four counties as the MSA core counties. The three Oregon Counties are served by Tri-Met, the Portland metropolitan area's largest transit agency.

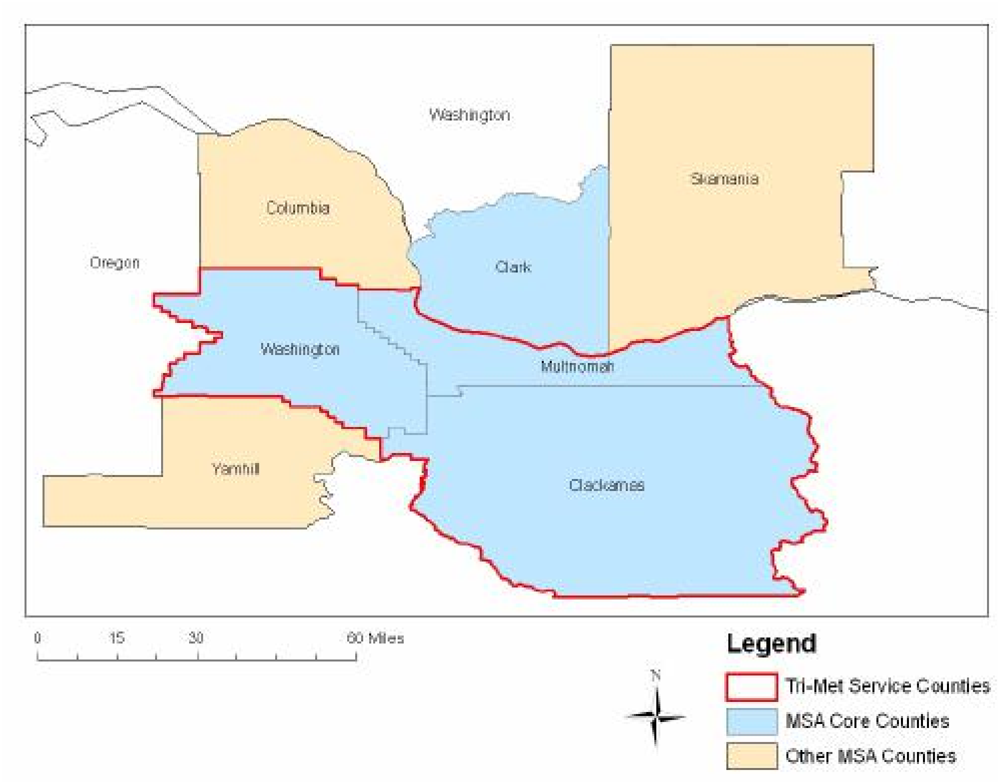


Figure 100 Portland metropolitan statistical area

Distribution of MSA Population

Portland is a growing metropolitan area. Population has increased and decentralized since 1970, as shown in Figure 101. This figure provides maps of population by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of population from Multnomah County at the center of the metropolitan area to Clackamas, Clark, and Washington Counties. The other MSA counties combined account for slightly more than 7% of the total metropolitan area population.

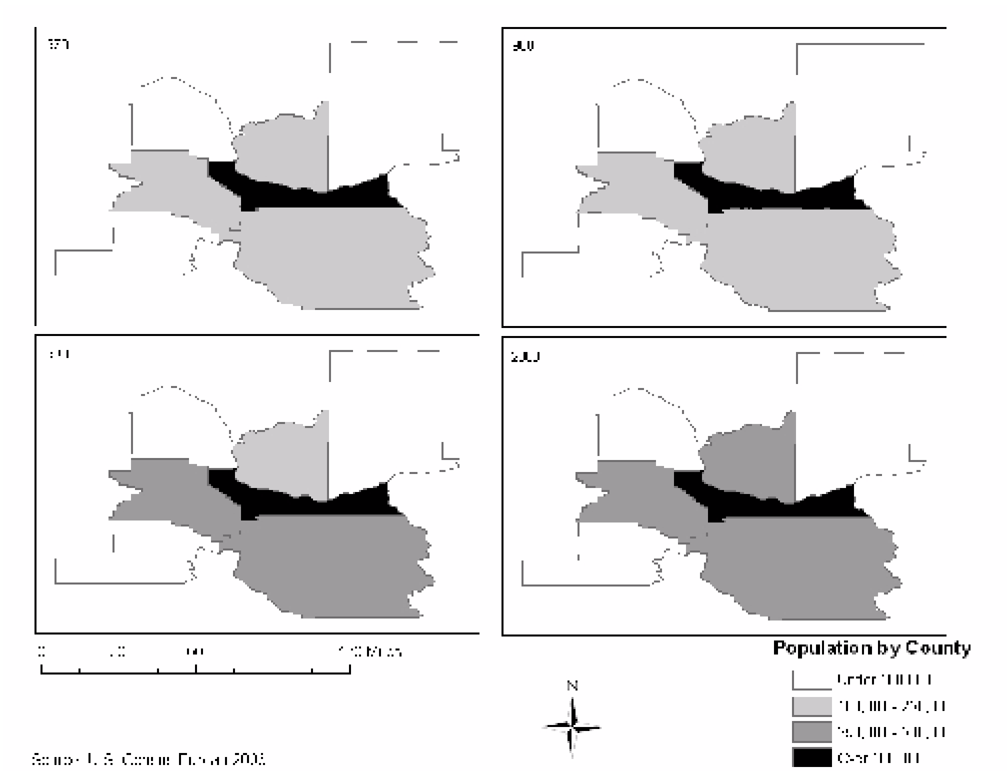


Figure 101 Portland MSA: population by county (1970–2000)

Between 1970 and 2005, total MSA population increased nearly 94% from 1.1 million to 2.1 million persons (see Table 101). Population has grown in the Tri-Met service area counties (75%), in the core counties as a whole (93%), and in the non-core MSA counties (102%). Steady growth in the three Tri-Met service area counties has helped them to retain about 80% of the total MSA population, only slightly less than they possessed in 1970. Oregon's urban growth boundary may be one factor accounting for the small amount of outer county population growth in the counties south of the Columbia River.

Since 1970, the fastest growing MSA core county has been Washington County (450%), with Clackamas County (340%) and Clark County (214%) immediately behind. Combined, the four MSA core counties have a total land area of 3,650 square miles and a population density of

530 persons per square mile.[188] The remaining three counties occupy 3,030 square miles and have a population density of 50 persons per square mile.[189]

Table 101 Population in the Portland metropolitan area (1970–2005)

Year	Tri-Met Service Area (3 counties)	MSA Core Counties (4 counties)	Other MSA Counties (3 counties)	Total MSA (7 counties)
1970	878,676	1,007,130	74,848	1,081,978
1971	893,200	1,027,900	77,400	1,105,300
1972	915,300	1,054,400	79,700	1,134,100
1973	929,500	1,076,200	81,600	1,157,800
1974	939,500	1,090,900	83,900	1,174,800
1975	949,900	1,106,800	85,700	1,192,500
1976	963,900	1,126,100	87,100	1,213,200
1977	984,000	1,152,600	89,900	1,242,500
1978	1,004,500	1,182,300	92,900	1,275,200
1979	1,029,400	1,216,000	96,300	1,312,300
1980	1,050,418	1,242,645	98,897	1,341,542
1981	1,067,196	1,264,059	100,464	1,364,523
1982	1,072,713	1,272,185	101,162	1,373,347
1983	1,070,026	1,269,699	101,308	1,371,007
1984	1,077,010	1,278,644	101,695	1,380,339
1985	1,083,611	1,289,217	102,207	1,391,424
1986	1,097,013	1,306,623	103,110	1,409,733
1987	1,104,415	1,318,949	104,289	1,423,238
1988	1,126,243	1,347,897	106,244	1,454,141
1989	1,149,592	1,378,352	108,865	1,487,217
1990	1,182,948	1,423,831	112,134	1,535,965
1991	1,217,809	1,469,981	114,786	1,584,767
1992	1,247,875	1,508,822	116,929	1,625,751
1993	1,277,852	1,550,111	119,590	1,669,701
1994	1,302,322	1,585,882	122,334	1,708,216
1995	1,328,874	1,623,530	125,694	1,749,224
1996	1,360,252	1,667,866	129,200	1,797,066
1997	1,387,093	1,707,677	132,190	1,839,867
1998	1,409,343	1,740,042	135,323	1,875,365
1999	1,429,233	1,768,774	137,488	1,906,262
2000	1,449,631	1,797,176	138,851	1,936,027
2001	1,476,329	1,835,387	140,709	1,976,096
2002	1,499,097	1,869,021	143,358	2,012,379
2003	1,514,483	1,894,331	145,948	2,040,279
2004	1,521,592	1,913,956	148,153	2,062,109
2005	1,541,170	1,944,936	150,925	2,095,861

Source: U.S. Census Bureau, 2007.

Figure 102 displays population density inside the Portland MSA for 2005, by transportation analysis zone (TAZ). Density is reported as persons per acre. The map clearly indicates that population concentrations on the Oregon side of the Columbia River are clustered inside the three Tri-Met service area counties. Within these counties, the city of Portland stands out as including a series of population centers, and suburban centers are also visible in both Washington and Clackamas Counties. The presence of the urban growth boundary undoubtedly helps to explain the pattern observed in this case study. North of the Columbia River, population is concentrated in southern Clark County, particularly in areas within a short distance of the Columbia River.

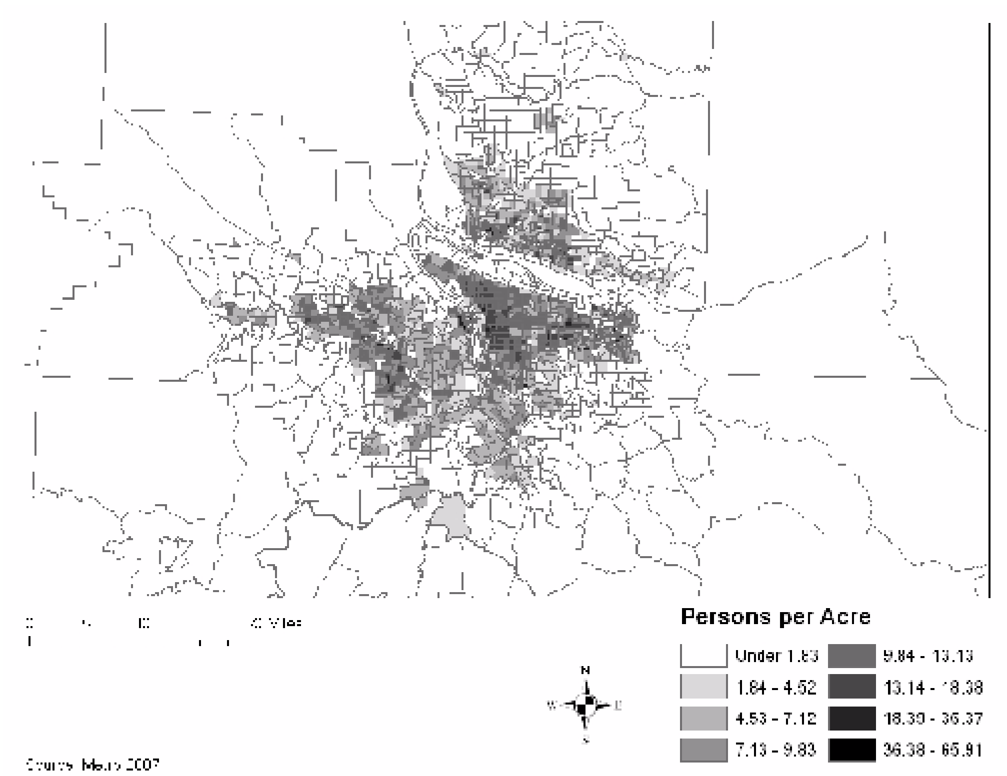


Figure 102 Portland MSA: population density by transportation analysis zone (2005)

Distribution of MSA Employment

Employment has grown and decentralized over the past several decades, but it remains much more concentrated than population. Figure 103 provides maps of employment by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of employment from Multnomah County to Washington County and then to the other MSA core counties. The maps show very little employment outside the MSA core counties.

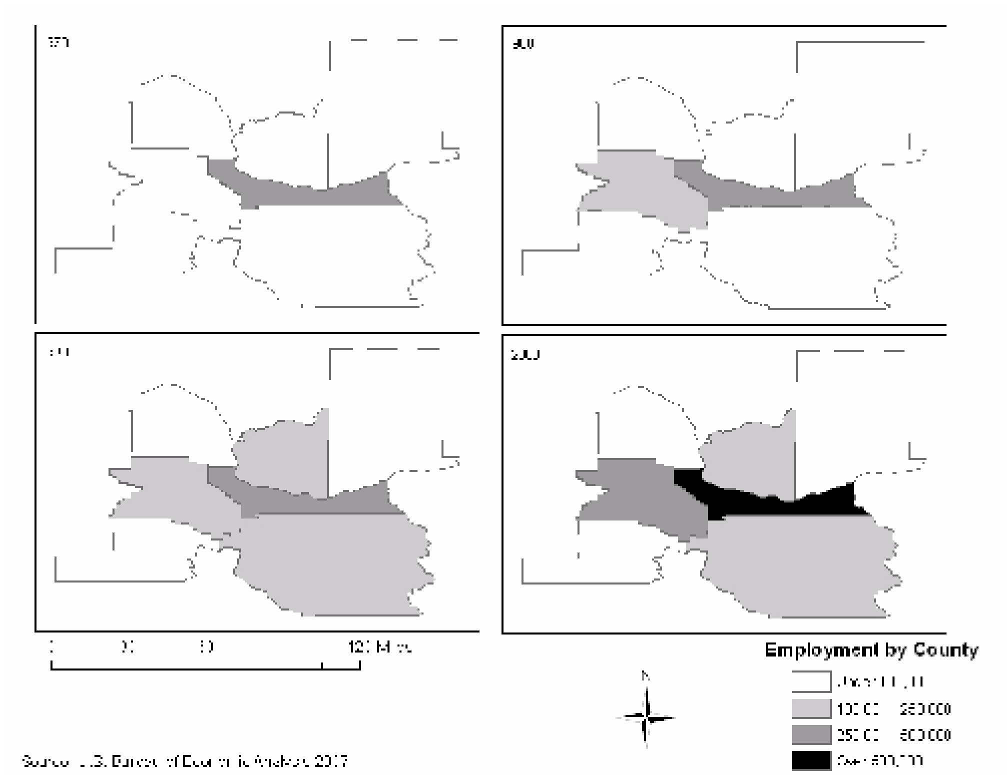


Figure 103 Portland MSA: employment by county (1970–2000)

Over the past several decades, total employment increased 160% from 500,000 to 1.3 million jobs (see Table 102). Employment growth in the Tri-Met service area counties has been slightly less (146%) than growth in the MSA core as a whole (161%). The Tri-Met service area counties accounted for 86% of MSA employment in 1970 and accounted for 81% of MSA employment in 2005. Thus, employment remains fairly concentrated.

Within the MSA core, employment has decentralized. The Portland central business district (CBD) has added a large number of jobs since 1970, but nearly all of that growth occurred between 1970 and 1990. By contrast, employment growth in suburban portions of the Tri-Met service area has been relatively steady between 1990 and 2005.

Figure 104 maps employment density in the Portland MSA for 2005, the most recent year for which detailed employment data are available. The map displays jobs per acre by transportation analysis zone (TAZ), using classification categories based on natural breaks in the data. The map shows that while the Portland CBD contains a major employment cluster, there are also additional employment clusters, particularly a string of employment clusters running into Washington County to the west. Clusters also occur in central Vancouver (Clark County), in Gresham (eastern Multnomah County), and in northern Clackamas County.

Table 102 Employment in the Portland metropolitan area (1970–2005)

Year	Portland CBD	Outside Portland CBD	Total	MSA Core Counties (4 counties)	Other MSA Counties (3 counties)	Total MSA (7 counties)
1970	30,000	399,697	429,697	472,746	24,345	497,091
1971	30,717	404,994	435,711	481,064	25,246	506,310
1972	31,451	427,715	459,166	508,186	27,108	535,294
1973	32,203	451,304	483,507	534,902	29,179	564,081
1974	32,972	466,882	499,854	552,494	30,507	583,001
1975	33,761	468,624	502,385	554,948	32,126	587,074
1976	34,567	485,790	520,357	577,184	32,657	609,841
1977	35,394	509,632	545,026	605,759	34,673	640,432
1978	36,239	544,857	581,096	646,456	36,851	683,307
1979	37,106	575,013	612,119	680,083	39,978	720,061
1980	38,000	582,532	620,532	689,389	40,824	730,213
1981	41,678	568,497	610,175	680,301	39,233	719,534
1982	45,713	545,470	591,183	660,102	37,215	697,317
1983	50,138	545,007	595,145	667,849	37,881	705,730
1984	54,991	566,567	621,558	698,815	38,902	737,717
1985	60,314	579,084	639,398	719,324	39,476	758,800
1986	66,153	589,683	655,836	739,310	40,675	779,985
1987	72,556	605,560	678,116	766,557	42,178	808,735
1988	79,580	631,891	711,471	807,831	43,852	851,683
1989	87,283	655,704	742,987	845,017	45,103	890,120
1990	95,734	675,050	770,784	878,370	46,710	925,080
1991	95,811	683,857	779,668	889,214	46,981	936,195
1992	95,887	691,240	787,127	900,003	47,714	947,717
1993	95,964	713,944	809,908	927,639	48,583	976,222
1994	96,041	753,030	849,071	977,977	50,878	1,028,855
1995	96,118	790,241	886,359	1,019,916	52,757	1,072,673
1996	96,194	828,157	924,351	1,064,003	55,746	1,119,749
1997	96,271	867,385	963,656	1,110,682	57,148	1,167,830
1998	96,348	890,559	986,907	1,139,049	57,141	1,196,190
1999	96,425	901,599	998,024	1,154,373	57,111	1,211,484
2000	96,490	926,996	1,023,486	1,182,408	57,824	1,240,232
2001	96,567	924,738	1,021,305	1,181,929	56,978	1,238,907
2002	96,644	907,231	1,003,875	1,165,360	57,351	1,222,711
2003	96,722	900,427	997,149	1,161,026	57,993	1,219,019
2004	96,799	917,355	1,014,154	1,184,549	59,400	1,243,949
2005	96,877	960,493	1,057,370	1,235,187	62,677	1,297,864

Sources: U.S. Bureau of Economic Analysis 2007; U.S. Census Bureau 1970, 1980, 1990, 2000.

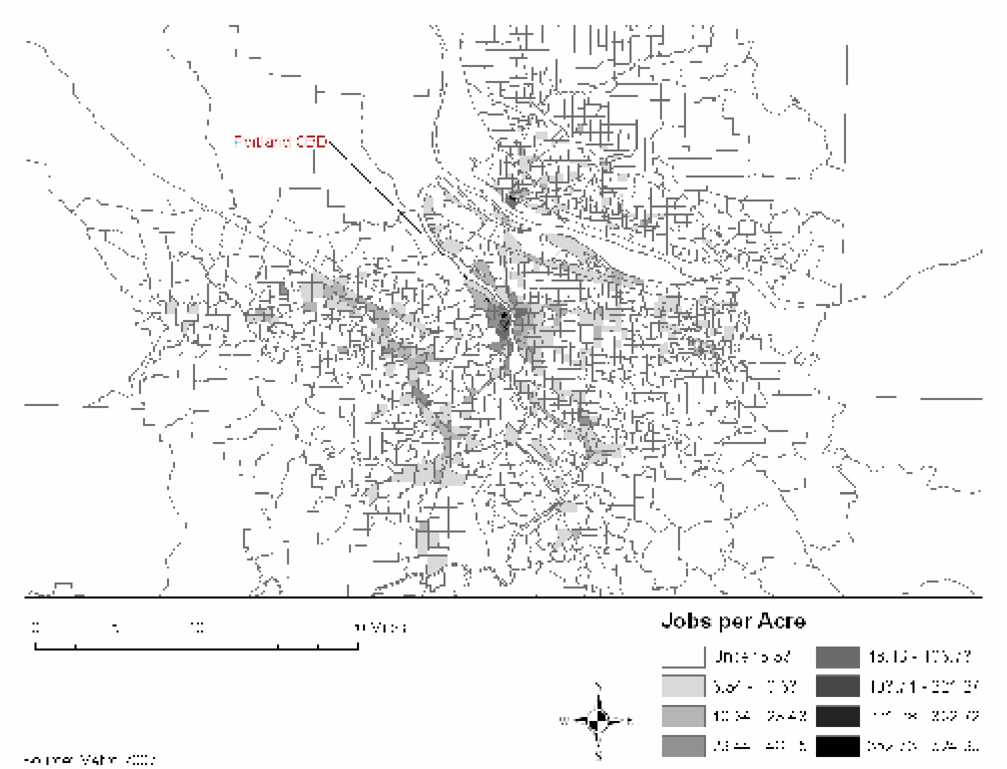


Figure 104 Portland MSA: employment density by transportation analysis zone (2005)

The Portland MSA emerges from this brief examination of population and employment growth and distribution as a growing, decentralized metropolitan area, but one where decentralization has been at least partially checked by the state of Oregon's urban growth boundary policy. Both population and employment are decentralized, but there are a number of employment clusters and/or employment-rich corridors that appear, particularly in Figure 104. This pattern of potential travel destinations has clear implications for the structure of the transit systems in the region. They suggest that transit service should be decentralized within the MSA core counties, and should provide good service to the major employment centers shown on the map. The authors discuss the Portland area's transit system later in the case study.

Institutions and Key Actors

A number of public sector entities play roles in the Portland metropolitan area's transit planning and policymaking process, including the two transit agencies, Metro, and a Joint Policy Advisory Committee.

Clark County Transit (C-Tran)

Clark County Transit (C-Tran) is the fixed-route public transit operator in Clark County, Washington. C-Tran provides local bus service inside Clark County and commuter services from Clark County to Portland.

Tri-Met

Tri-Met is the primary transit operator in the Portland metropolitan area, operating light rail and bus transit services. Tri-Met is governed by a seven-member board of directors, appointed by the Governor of Oregon, each of whom represents a specific geographic area for a four-year term.

Metro

Metro is the elected regional government consisting of Clackamas, Multnomah, and Washington Counties in Oregon. Metro is governed by a seven-member elected council. Metro serves as the metropolitan planning organization (MPO) for the Portland area. In this role, Metro approves the short-range Transportation Improvement Program (TIP) and Long Range Transportation Program (LRTP) required for all federal-aid projects.

Joint Policy Advisory Committee (JPAC)

The Joint Policy Advisory Committee on Transportation consists of local elected officials, members of the Metro Council, and Tri-Met's director. This organization sets regional transportation policy in the Portland area.

Transit Agencies, Modes, Fares, and Rider Profiles

There are two transit agencies in the Portland metropolitan area. Clark County Transit (C-Tran) provides service inside Clark County and between Clark County cities and Portland. Tri-Met is the primary transit operator in the region, and provides service on the southern side of the Columbia River. The authors briefly note C-Tran's services, but focus most our attention on Tri-Met.

Small Transit Agency Services, Fares, and Ridership

C-Tran operates 28 bus routes, of which 11 are designated as express or limited-stop commuter services.[190] The seven express routes among these eleven provide service to the Portland CBD, while the four limited-stop routes connect Clark County to MAX LRT stations immediately across the Columbia River. Local bus fares for service inside Clark County are $1.25 for adults, with discounted fares for senior citizens, the disabled, and youths. Express bus fares to Portland are $3.00 per ride. C-Tran also sells multi-ride tickets and day and monthly passes, at a discounted price. C-Tran riders may pay an additional $.50 to $1.25 (depending on type of service and pass) to transfer to Tri-Met services. Tri-Met riders also pay a variable fee for transfers to C-Tran services. C-Tran also provides paratransit service.

C-Tran fixed-route bus service and ridership have grown significantly since 1984 (see Table 103). Unlinked passenger trips have tripled and passenger miles quadrupled, as service has doubled. The result is increased ridership and higher load factors on C-Tran routes. Both ridership and service peaked in the late 1990s and have declined since that time.

Table 103 Clark County Transit (C-Tran) ridership and service (1984–2004)

Year	Passenger Miles	Passenger Trips	Vehicle Miles
1984	9,481,458	2,260,256	2,153,673
1985	13,714,414	3,110,669	2,157,640
1986	10,904,634	2,553,562	2,052,424
1987	13,403,684	2,536,864	2,100,601
1988	11,413,102	2,225,808	2,291,200
1989	12,701,792	2,564,126	2,536,470
1990	23,202,757	4,092,253	3,100,202
1991	15,928,727	3,645,916	3,094,997
1992	13,259,772	3,637,600	3,118,792
1993	21,988,044	4,255,417	3,186,151
1994	23,237,291	4,806,285	3,651,352
1995	28,306,655	5,153,190	3,526,803
1996	31,803,968	5,985,456	3,908,548
1997	33,804,994	6,658,550	4,542,174
1998	37,935,106	7,208,587	5,029,537
1999	42,011,749	7,750,095	5,275,297
2000	35,185,123	6,564,961	4,656,608
2001	32,070,824	5,954,946	4,103,129
2002	30,905,761	6,215,424	4,158,718
2003	35,570,764	6,669,074	4,108,899
2004	37,945,869	6,804,572	4,168,732

Source: Florida Department of Transportation, 2006.

Tri-Met Services and Fares

Tri-Met is the primary transit agency in the Portland area (see Figure 105), operating bus and light rail transit service in Clackamas, Multnomah, and Washington Counties. Tri-Met classifies its bus services into two types: regular bus and frequent (service) bus. Of 94 bus routes, 17 routes are classified as frequent (service) bus. Tri-Met's bus routes are nearly evenly divided between CBD-serving (48 routes) and non-CBD-serving (46 routes) routes. Tri-Met's MAX light rail system includes three lines: Blue Line (Hillsboro to Gresham), Red Line (Airport to Beaverton), and Yellow Line (Expo Center to City Center). All three MAX lines serve the Portland CBD. The MAX lines date to the mid-1980s (see Table 104). Tri-Met also operates paratransit service.

Tri-Met has a zone-based fare system featuring three zones;[191] it also has a fare-free zone called the fare-less square in the CBD. Tri-Met has extended the fare-free zone across the Willamette River to the Lloyd Center area as a way of tying that area in with the CBD. Tri-Met sells two-hour tickets, multi-ticket books, day passes, multi-day passes, half-monthly passes, monthly passes, and annual passes. The adult single-zone fare is $1.75, with an all-zone adult fare costing $2.05. Transfers are free to other Tri-Met bus and rail services within the time window covered by the fare purchase. Tri-Met riders may pay to transfer to C-Tran services. Senior citizens and youths are eligible for discounted fares.

One of this study's interviewees observed that fares have gone up faster than inflation in recent years. This contact was also concerned that the zone-based fares might be pricing short trips off the transit system, because he believed that the zones are too large. When Tri-Met replaces its fare boxes, they will move to Smart Cards. These fare media have the potential to be used for other kinds of fare structures. However, this contact noted that top management has not yet been persuaded to implement any alternative fare structures or to adjust the zone fare differentials.

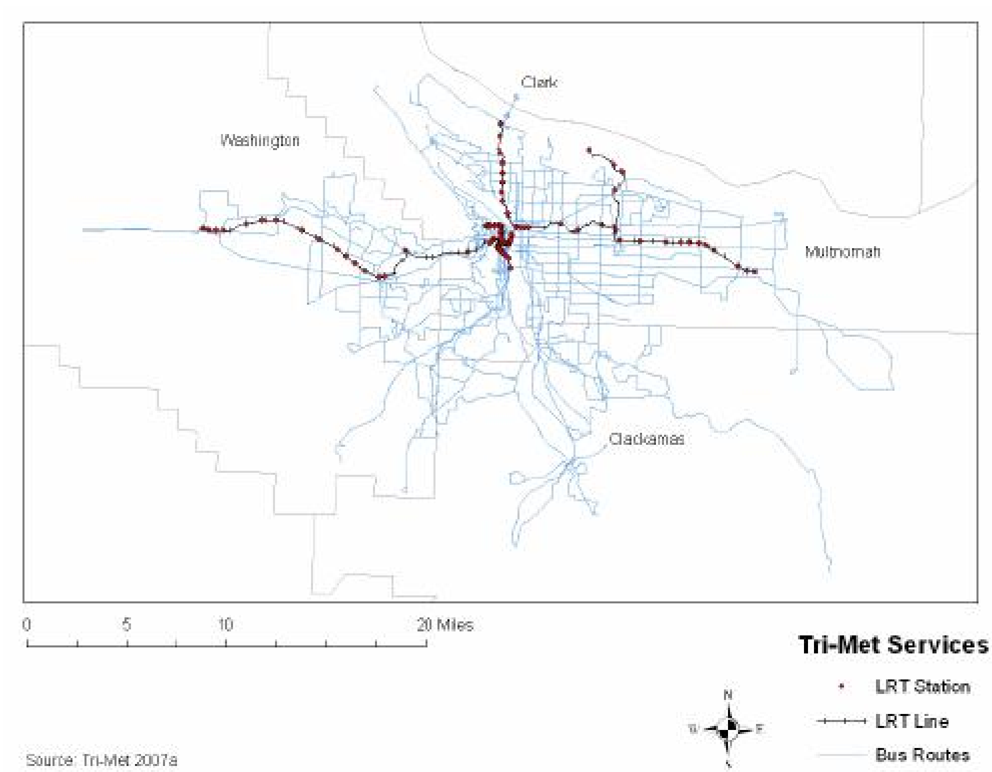


Figure 105 Tri-Met Transit System (2007)

Table 104 Portland light rail transit segment openings since 1986

Year	Segment Length	Line	Section	Cumulative Length
1986	15.1	Eastside MAX (Blue Line)	11th Avenue–Cleveland Avenue	15.1
1997	0.5	Westside MAX (Blue Line)	11th Avenue–Goose Hollow/SW Jefferson	15.6
1998	16.9	Westside MAX (Blue Line)	Goose Hollow/SW Jefferson–Hatfield Government Center	32.5
2001	5.5	Airport MAX (Red Line)	Gateway/NE 99th Avenue TC–Portland International Airport	38.0
	2.5	Portland Streetcar	Good Samaritan Hospital–Portland State	40.5
2004	5.8	Interstate MAX (Yellow Line)	Interstate/Rose Quarter–Expo Center	46.3
2005	0.6	Portland Streetcar	Portland State–River Place	46.9
2006	0.6	Portland Streetcar	River Place–SW Moody/Gibbs	47.5

Source: Leroy Demery, *U.S. Urban Rail Transit Lines Opened from 1980*, October 18, 2005.
Notes: Interstate MAX (Yellow Line) opened May 1, 2004.
Portland Streetcar extension from Portland State to RiverPlace opened March 11, 2005.
Portland Streetcar extension from RiverPlace to SW Moody/Gibbs opening planned for September 8, 2006.

Tri-Met Ridership Profile

Tri-Met conducted origin-destination surveys that allow this study's authors to develop a profile of Portland transit riders. Table 105 reports the weekday ridership demographics, in terms of gender and income, of Portland transit users by mode of service. Riders are fairly evenly split between male and female. Half of all weekday Tri-Met riders reported earning a household income of less than $30,000 per year.[192] A 2004 Tri-Met telephone survey reported that the median annual income of MAX riders is more than $60,000.[193] Bus riders are more likely to report lower household incomes. More than half of weekday bus riders report earning less than $30,000, while less than 40% of MAX riders reported similar income levels.[194] The authors examined weekend survey data as well, and found very minimal variation from the weekday information presented in the tables in this section of the case study.

A large proportion of weekday Tri-Met riders either do not have a car available for their use, or cannot or do not drive, and thus can be considered transit dependent (see Table 106). Bus users were more likely to be transit dependent than MAX or streetcar users.[195] Fifteen percent of all weekday riders do not own a vehicle specifically because they prefer to use Tri-Met instead of driving. Half of all weekday Tri-Met riders utilize a combination of transit modes (see Table 107).

Table 105 Demographics of Tri-Met riders

Survey Category	Response	Streetcar Percent	MAX Percent	Bus Percent	Total Percent
Gender	Male	52	53	48	50
	Female	48	47	52	50
Income	Under $10,000	22	14	23	20
	$10,000 to $29,999	26	24	33	30
	$30,000 to $49,999	20	18	19	19
	$50,000 to $69,999	8	13	10	11
	$70,000 or more	17	21	10	13
	Don't know	7	9	5	7

Source: *Portland 2000-2004 Origin/Destination Study*, provided to authors by TriMet Staff, 4.

Note: Rates given reflect weekday demographic information.

Table 106 Reasons riders use Tri-Met transit services

What is the major reason you are using bus/MAX for this trip?	Streetcar Percent	MAX Percent	Bus Percent	Total Percent
I do have a car but prefer to use Tri-Met	49	57	34	41
I don't have a car because I prefer to use Tri-Met	21	11	17	15
I don't have a car available for me to use	23	23	32	29
I don't drive or don't know how to drive	8	9	17	15

Source: TriMet, *Portland 2000–2004 Origin/Destination Study*, provided to authors by TriMet Staff, 3.

Note: Rates given reflect weekday data.

Table 107 Modes used by Tri-Met riders

Transit Type Used	Total Percent
Combination Bus, MAX, Streetcar	50
MAX Only	31
Bus Only	18
Streetcar Only	1

Source: TriMet, *TriMet Attitude and Awareness Survey 2004*.

ANALYSIS

Regional Transit Vision

The interviewees described the regional transit vision in Portland and its evolution over time.[196] One of the interviewees noted that there was not a strong regional vision when he arrived in the region in the early 1980s. At that time, the vision for transit (such as it was) was articulated by people at the City of Portland. However, this contact observes that in the subsequent years a regional vision emerged: one that uses light rail transit (LRT) as a planning tool to focus growth. Key to the emergence of this regional vision was the granting of greater regional land use planning authority to Metro. One interviewee characterized the primary objective of contemporary rail transit development as being to shape growth and then enjoy the associated land use and environmental benefits. Portland has a functional classification system for its transit services that is tied in with its long-range transportation and land use planning processes.

According to the interviewees, there is a sense among many people in the region that LRT serves as a substitute for freeways structured as radials to the center of the region. One interviewee observed that over the past decade the major transportation investments in the region have all been transit; not much money has been spent on highway projects. Compared to freeways, LRT is seen as being less expensive, more environmentally friendly, and more supportive of desired land use outcomes. One interviewee noted that there is some interest in developing circumferential highway links. This same interviewee characterized a commuter rail project between Wilsonville and Beaverton, to the west of Portland, as an experiment in developing circumferential transit service. This service will be peak period only, and the project is presently under construction. Tri-Met has no plans for using express bus services to serve a circumferential function.

Portland’s transit system has been characterized as following a multidestination service orientation, but there was disagreement between our interviewees as to whether the focus on multidestination service that once characterized the region's transit vision was still strong. One interviewee emphasized that the vision was still present, and was reinforced by Metro’s long-range land use plan. This contact characterized the Portland CBD and six or seven other centers as major focal points for transit service. However, this same contact said the multidestination service philosophy has been hindered by a lack of operating dollars to expand bus service. Tri-Met has reduced bus service in recent years due to pressures from operating both paratransit service and LRT service. As LRT comes online, Tri-Met has tried to restructure its bus service and reallocate more service to crosstown routes. The authors’ contact observed that this did not happen with the most recent LRT opening because little bus service was removed, and it is not likely to happen when the LRT line on Interstate 205 opens for the same reason.

The other contact characterized the transit system as downtown-oriented, not a multidestination system. This contact said local policymakers have little understanding of the multidestination concept. This contact observed that the greatest increase in ridership occurred when routes were restructured to implement a multidestination approach in the 1980s. Downtown interests have succeeded in attracting new capacity to LRT in the downtown, despite bottlenecks at the bridge across the Willamette River.

This contact pointed to this strategy and the recent push to develop local circulator streetcars (like the loop to the Lloyd Center) as resulting in less money for bus operations. This contact also argued that bus service has declined in recent years, and so has bus ridership. The focus on CBD-focused LRT and streetcar circulators has prevented Tri-Met from adding crosstown bus routes in several travel corridors and resulted in suburban areas not receiving needed services.

The other interviewee noted that local travel models suggest the CBD is the best ridership market, although this contact described the current plan for three east side LRT lines to serve the CBD as perhaps too much. This contact also observed that downtown block lengths (and short train platforms in many areas) preclude the use of longer LRT trains, and might necessitate the eventual development of a downtown subway. This person foresees rail perhaps evolving into a grid over time and becoming less CBD oriented. Right now, however, it is very much a CBD-focused rail system.

Regional Transit System Structure and Function

Presently, the regional transit system in Portland is split at the Columbia River into the portion of the region dominated by C-Tran and the portion of the region dominated by Tri-Met. There are, however, a handful of routes that cross the Columbia River. One of our interviewees noted that there is presently a bi-state study looking at the potential for more transit running on Interstate 5 across the Columbia River. This contact observed that an LRT extension is part of the discussion in this study. However, there are serious hurdles, most prominently that many older bridges that have lift spans would need to be replaced. There are also some concerns about being able to obtain the money to fund whatever recommendation comes out of the study. Tri-Met is dependent on the payroll tax as a primary revenue source, and this revenue source is very sensitive to economic cycles. A more reliable, stable funding mechanism would be required.

Within the Tri-Met part of the system, the transit network has evolved from a multidestination to an increasingly CBD-focused system, although Figure 105 indicates that many bus routes follow a modified grid pattern. Within the CBD, the transit mall has served as a focal point for transit services. The original mall was developed to stimulate development in the downtown and to consolidate services and simplify routing. One of the contacts observed that the mall has not stimulated development. This contact observed that Tri-Met has not provided the off-peak service frequencies that are provided in more successful settings, such as Denver. This contact also noted that the mall has attracted a derelict population, and thus businesses do not view its presence very favorably.

The second interviewee observes that the mall has aged. This contact pointed to the development of a new mall alignment, and the addition of more LRT, as a way of revitalizing the downtown. The new mall, with its $160 million to $200 million estimated price, will run both LRT and buses, although it will handle fewer buses than the current mall.

Transfers

Portland was once known for its multidestination system, although its recent spate of CBD-focused projects and the decline in bus service due to financial circumstances indicate a departure from the multidestination philosophy. Nevertheless, portions of the system still feature multidestination elements, which necessitate the use of transfers to connect more origins and destinations, and thus boost ridership and service efficiency. One of the interviewees lamented that local officials and members of the public do not seem to appreciate this fact.

According to Tri-Met's origin-destination survey, most Tri-Met riders do not transfer while making their trip, although this number varies depending on the modes used (see Table 108). Streetcar riders were the least likely to transfer to complete their trip, while bus riders were the group most likely to transfer. The authors used the data in the table to estimate transfer rates for each type of service. From the table, they obtained the following transfer rates for one-way trips: streetcar (17%), MAX (33%), bus (37%), and total (35%).

Table 108 Transfers made by Tri-Met riders to complete a one-way trip

How many times did you have to transfer	Streetcar Percent	MAX Percent	Bus Percent	Total Percent
0	83	74	68	70
1	15	23	28	26
2	1	3	3	3
3 or more	0	1	1	1

Source: TriMet, *Portland 2000-2004 Origin/Destination Study*, provided to authors by TriMet Staff, 3.
Note: Rates given reflect weekday transfer rates.

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

Portland is one of the few metropolitan areas in the country that has experienced both increasing riding habit and increasing service productivity. Figure 106 plots riding habit (passenger miles per capita) from 1984 to 2004. The figure shows a largely upward trend, particularly from the mid-1990s to the present. During this period, Tri-Met opened segments of its light rail system, and particularly the Westside LRT line. At the time of Westside LRT opening, Tri-Met restructured Westside bus services to act more as feeders and distributors for rail transit. The riding habit graph indicates that the combined strategy of LRT plus restructured bus service was an effective one. One of our interviewees also cited Tri-Met's earlier strategy of providing good evening and weekend service as responsible for the riding habit gains.

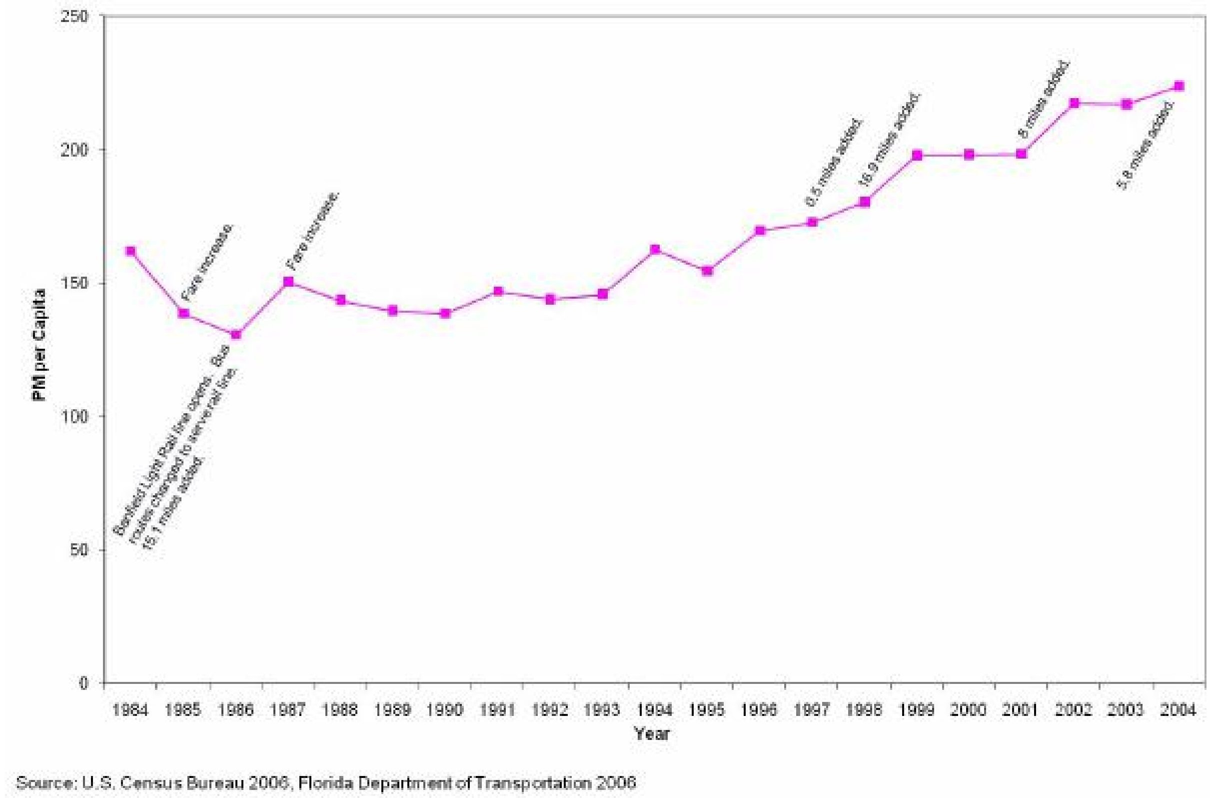


Figure 106 Portland MSA riding habit (passenger miles per capita) (1984-2004)

Figure 107 provides a portrait of service productivity over the same 1984 to 2004 period. Service productivity (measured as passenger miles per vehicle mile, or load factor) has increased since 1984, with the most recent upward trend dating back to the early 1990s. This trend is particularly striking, because service productivity is in decline nationally. The upward trend in service productivity parallels the increase in ridership, suggesting that the service changes implemented to attract riders are very effective indeed.

Tri-Met System Ridership and Productivity Trends

Table 109 looks more closely at ridership by mode for Tri-Met's bus and light rail service. Tri-Met bus ridership declined in the mid to late 1980s before stabilizing and then increasing in the late 1990s. Rail ridership increased dramatically as rail segments opened. The tables end with 2004 ridership data. However, one of the interviewees noted that ridership is still growing on rail, while bus ridership is flat. This contact attributed rail ridership growth to a combination of land use planning (strong central city, urban growth boundary), employment growth, and population growth.

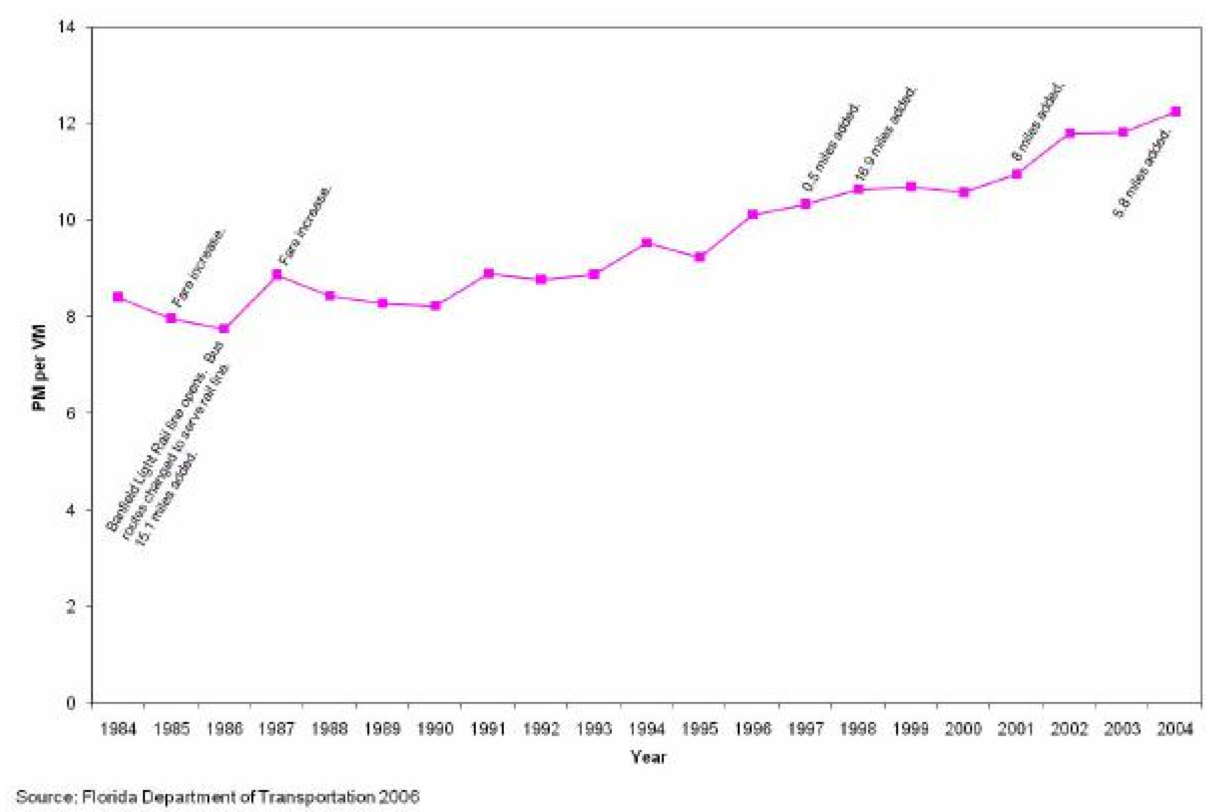


Figure 107 Portland MSA load factor (passenger miles per vehicle) (1984–2004)

Table 109 Ridership on Tri-Met fixed route transit services (1984–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	Tri-Met Bus	Tri-Met Rail	Tri-Met Total	Tri-Met Bus	Tri-Met Rail	Tri-Met Total
1984	213,977,290		213,977,290	49,460,420		49,460,420
1985	179,165,610		179,165,610	54,839,417		54,839,417
1986	173,206,190		173,206,190	50,394,239		50,394,239
1987	171,794,753	29,116,255	200,911,008	45,967,684	4,961,772	50,929,456
1988	164,909,440	32,365,841	197,275,281	48,248,529	5,585,530	53,834,059
1989	159,969,173	34,956,643	194,925,816	44,926,315	6,184,884	51,111,199
1990	151,195,759	38,270,941	189,466,700	47,820,724	6,414,290	54,235,014
1991	175,827,851	40,895,614	216,723,465	51,246,088	6,981,929	58,228,017
1992	179,360,220	41,292,221	220,652,441	53,316,365	7,702,542	61,018,907
1993	178,165,945	43,142,869	221,308,814	52,484,639	7,770,651	60,255,290
1994	208,089,731	46,418,361	254,508,092	54,792,664	8,482,255	63,274,919
1995	202,295,950	39,689,969	241,985,919	56,216,974	7,779,507	63,996,481
1996	225,295,110	47,866,023	273,161,133	60,696,022	10,047,947	70,743,969
1997	229,358,461	54,727,726	284,086,187	60,260,035	10,432,414	70,692,449
1998	237,049,756	63,299,139	300,348,895	67,072,805	11,846,048	78,918,853
1999	206,844,098	128,491,830	335,335,928	58,926,058	22,723,534	81,649,592
2000	207,760,486	140,859,890	348,620,376	61,818,756	24,362,806	86,181,562

Table 109 Ridership on Tri-Met fixed route transit services (1984–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	Tri-Met Bus	Tri-Met Rail	Tri-Met Total	Tri-Met Bus	Tri-Met Rail	Tri-Met Total
2001	216,054,689	144,023,605	360,078,294	65,427,872	24,976,610	90,404,482
2002	239,044,998	167,554,612	406,599,610	71,120,321	28,253,547	99,373,868
2003	237,345,046	169,571,618	406,916,664	66,434,912	31,149,038	97,583,950
2004	241,598,358	181,760,354	423,358,712	65,938,456	31,516,208	97,454,664

Source: Florida Department of Transportation, 2006.

Table 110 reports average trip length for bus and rail trips, calculated using the unlinked passenger trip and passenger mile data shown in Table 109. The table indicates that bus trip lengths declined during the mid-to-late 1980s and have fluctuated between 3.3 and 3.7 miles since the late 1990s. The table shows that rail trip lengths have also fluctuated, although not very widely given the increasing length of the light rail transit system.

Table 110 Average trip lengths (Tri-Met) (1984–2004)

Year	Average Trip Length (miles)		
	Tri-Met Bus	Tri-Met Rail	Tri-Met Total
1984	4.33		4.33
1985	3.27		3.27
1986	3.44		3.44
1987	3.74	5.87	3.94
1988	3.42	5.79	3.66
1989	3.56	5.65	3.81
1990	3.16	5.97	3.49
1991	3.43	5.86	3.72
1992	3.36	5.36	3.62
1993	3.39	5.55	3.67
1994	3.80	5.47	4.02
1995	3.60	5.10	3.78
1996	3.71	4.76	3.86
1997	3.81	5.25	4.02
1998	3.53	5.34	3.81
1999	3.51	5.65	4.11
2000	3.36	5.78	4.05
2001	3.30	5.77	3.98
2002	3.36	5.93	4.09
2003	3.57	5.44	4.17
2004	3.66	5.77	4.34

Source: Florida Department of Transportation, 2006.

Table 111 provides information about transit service between 1984 and 2004. The table reports that bus service has changed remarkably little during this period. The interviewees noted that the amount of bus service has stagnated in recent years. Rail service on the other hand has increased as rail line segments have opened.

The division of ridership by service yields the service productivity data reported in Table 112. Here one see that service productivity (defined as passenger miles per vehicle mile, or load factor) has increased since 1984. Bus service productivity has increased slightly since 1984, although it experienced peaks and valleys during the intervening years. Bus service productivity reached its heights in 1998, upon the opening of the Westside LRT and the restructuring of Westside bus service. At that time, rail took over the trunk portions of several bus routes, and bus productivity declined somewhat. Overall rail productivity declined as well, as the rail line doubled its length, but since that time bus, rail, and overall system productivity have rebounded. The changes in productivity indicate a successful strategy of implementing rail as well as the means by which passengers would access and depart rail (whether through bus and bus service restructuring or through the provision of good park and ride infrastructure).

Table 111 Tri-Met fixed route transit service (1984–2004)

Year	Vehicle Miles		
	Tri-Met Bus	Tri-Met Rail	Tri-Met Total
1984	24,401,470		24,401,470
1985	22,045,817		22,045,817
1986	21,688,621		21,688,621
1987	20,944,439	1,105,592	22,050,031
1988	20,998,487	1,420,371	22,418,858
1989	21,127,569	1,415,002	22,542,571
1990	21,384,936	1,347,807	22,732,743
1991	21,616,597	1,429,531	23,046,128
1992	22,073,394	1,461,076	23,534,470
1993	22,683,761	1,517,875	24,201,636
1994	23,908,754	1,567,759	25,476,513
1995	24,169,804	1,553,240	25,723,044
1996	24,665,828	1,545,200	26,211,028
1997	24,626,294	1,594,255	26,220,549
1998	25,043,291	1,732,103	26,775,394
1999	25,566,192	4,464,310	30,030,502
2000	26,554,404	5,079,456	31,633,860
2001	26,622,622	5,079,088	31,701,710
2002	27,210,737	5,695,914	32,906,651
2003	27,467,824	5,857,309	33,325,133
2004	27,392,002	6,109,022	33,501,024

Source: Florida Department of Transportation, 2006.

Table 112 Tri-Met service productivity (1984–2004)

Year	Tri-Met Bus	Tri-Met Rail	Tri-Met Total
1984	8.77		8.77
1985	8.13		8.13
1986	7.99		7.99
1987	8.20	26.34	9.11
1988	7.85	22.79	8.80
1989	7.57	24.70	8.65
1990	7.07	28.39	8.33
1991	8.13	28.61	9.40
1992	8.13	28.26	9.38
1993	7.85	28.42	9.14
1994	8.70	29.61	9.99
1995	8.37	25.55	9.41
1996	9.13	30.98	10.42
1997	9.31	34.33	10.83
1998	9.47	36.54	11.22
1999	8.09	28.78	11.17
2000	7.82	27.73	11.02
2001	8.12	28.36	11.36
2002	8.78	29.42	12.36
2003	8.64	28.95	12.21
2004	8.82	29.75	12.64

Source: Florida Department of Transportation, 2006.

Bus Route Performance

The authors examined bus route performance in more detail to determine the types of routes that are performing best in the Tri-Met system. Tri-Met's classification scheme differentiates between frequent service (low headway) and regular routes. They further differentiated among the routes on the basis of whether the route serves the Portland CBD or not. As our measure of route performance, the authors obtained the number of unlinked passenger trips per revenue hour of service for the average weekday, Saturday, and Sunday.

Table 113 reports the results of our performance investigation. The table reports the performance of the median route within each of four route groups. The table shows that among all routes, CBD-serving routes outperform their non-CBD-serving counterparts on weekdays and that the types of routes are quite similar in their performance on weekends. The table shows that when the authors further stratify the routes to focus on the frequent-service routes, the advantage enjoyed by CBD-serving routes disappears. Non-CBD-serving frequent service routes perform just as well as their CBD-serving counterparts on weekdays, and outperform them on weekends. Portland's bus routes compare very favorably in their performance to their counterparts in the other study cities. Portland's bus routes rank second among the eleven study cities in most service type categories.

Table 113 Tri-Met bus route performance

Route Type	Number of Routes	Trips per Revenue Hour (median)		
		Weekday	Saturday	Sunday
All bus routes	94	33.80	30.00	29.55
All CBD-serving routes	48	38.00	31.90	30,20
CBD-serving frequent service routes	14	53.30	40.85	33.75
All non-CBD routes	46	28.00	32.31	29.30
Non-CBD frequent service routes	3	53.20	46.50	41.70

Source: Tri-Met 2007b, Tri-Met 2007c.

Rail Station Entries

Figure 108 depicts average weekday boardings at Portland's light rail stations. The figure reveals a complex pattern of usage reflecting the light rail system's function as the central part of a multidestination transit system. Stations serving the CBD stand out for their heavy usage, as do those in the formerly dying suburban mall, Lloyd Center, located across the river from the CBD. The next category of heavily-used stations includes those where city and suburban bus transfers occur. Cedar Hills and Beaverton on the west side stand out in this regard as does Gateway and N.E. 82nd Avenue on the east side. Only one bus route connects with light rail at N.E. 82nd Avenue, Route 72, but Route 72 is the most heavily patronized single bus line in the entire Portland region. Neighboring stations at N.E. 60th Avenue and Hollywood connect with other north-south cross-town bus routes. Route 75 crossing the light rail line at the Hollywood station is the second most heavily traveled bus route in the Portland region. The outer ends of both the east and west side light rail lines serve mixtures of residential and employment districts, resulting in the outer stations being both origins and destinations at any time of the day. This feature boosts average load factors on the outer ends of the line, resulting in an overall high level of productivity.

The recently-opened interstate MAX light rail line running north from Lloyd Center is the weakest performing light rail line. It is a relatively slow line running in the median of an arterial road serving an older part of the city with medium densities and no concentrations of major destinations. It does connect with strong east-west bus routes at several stations. If extended into Clark County its patronage will jump, but its slow speed will remain an issue that may prevent the line from achieving its potential.

The Portland streetcar also is relatively new and is being extended. It serves primarily as a circulator for the increasingly mixed residential, commercial, retail, office, and educational activity permeating all parts of the vibrant central business district. The line is slow, and usage is moderate compared to that of the light rail lines.

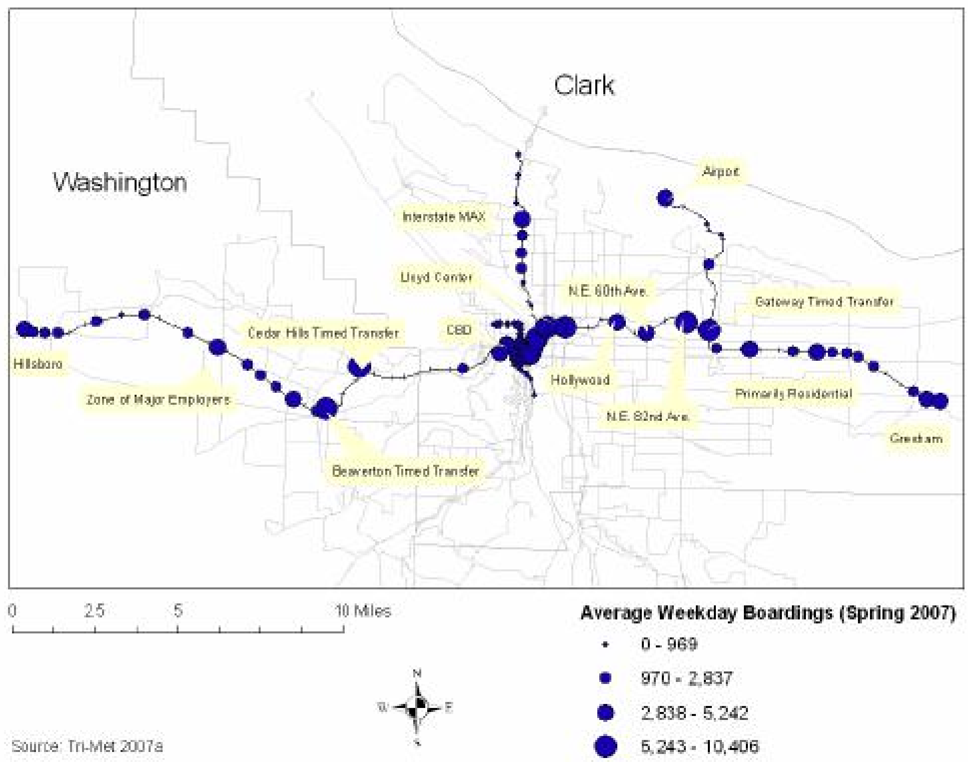


Figure 108 Tri-Met average weekday light rail boardings by station (Spring 2007)

Emerging and Declining Ridership Markets

The study's interviewees identified a number of important, growing ridership markets in the Portland area. One interviewee pointed to the reverse commute market on the Westside LRT as a growing market. This person noted that there is now roughly one reverse commuter for every 3 inbound commuters on the line. The same person observed that the reverse commute activity is three times as large as it was on the buses that preceded LRT. Also on the Westside, Tri-Met has seen growth in regional (although not local) trips. The authors' contact noted that a challenge on the west side is making the last link from LRT to the very substantial businesses that are located there. Bus service runs on 30 minute headways, so making connections can be difficult. Some employers are running shuttles to and from LRT stations to provide these connections. Tri-Met also sees a lot of bicycling to and from trains, particularly in the reverse commute direction. This same contact says that slow travel times through the CBD probably suppress reverse commute ridership from east side residences to west side jobs.

The authors noted earlier that rail ridership is increasing but bus ridership is flat. One interviewee attributed this condition to Tri-Met's unwillingness or inability (because of funding limitations) to put more strong crosstown bus lines on major arterial roads that cross the region. Tri-Met's best performing bus routes are in this category, but they are few in number, and there are many arterial roads without such bus routes. The first and second most heavily-traveled bus routes in the Portland region today, Route 72 on 82nd Avenue/Killingsworth and Route 75 on 39th Avenue, are crosstown local routes. In the mid-1970s the 82nd Avenue route had hourly service and almost no ridership. One of the interviewees was the first instigator for improving service on that route, but the Tri-Met management of that time scoffed at the idea, saying there was no demand for crosstown service.

In the early 1980s after a change of personnel, Tri-Met undertook a major restructuring of bus routes on the east side by eliminating several east-west lines that served the CBD and using the bus hours thus freed up to strengthen three north-south crosstown lines, including routes 72 and 75. Subsequently during a time of recession Tri-Met ridership fell except in the west and east sides where bus service had been restructured. In those areas ridership grew substantially. It grew the most, almost 100%, on the three east side crosstown routes.[197] (The third crosstown is Route 71, which today is also in the top one third of Tri-Met's best performing routes.) After the September 1986 introduction of the Banfield light rail transit line, these three crosstown bus routes became strong feeder and distributor connections to the east-west running light rail line. This interviewee believes that more bus service of this type would further boost regional transit ridership.

Demand for other types of local bus service may be stagnating, however. Tri-Met's first move away from a CBD-radial bus system occurred in 1979 when it implemented a timed-transfer bus reorganization on the west side, focused on new transit centers at Cedar Hills and Beaverton. The restructuring was service-neutral, in that it did not increase bus hours. It made many patrons transfer who previously had a direct peak period express bus from their house to the Portland CBD. In return, the region received all-day bus service focused on two timed transfer centers, from which regular all-day service operated to the CBD, to local employers, and to the region's major mall. Ridership increased substantially.[198]

More recently, in 1998 when light rail was extended to the west side, it plugged into the Cedar Hills and Beaverton timed transfer centers that were first implemented in the bus route restructuring of 1979. The introduction of light rail stimulated a further growth of bus patronage on the local west side bus routes that focused on these timed transfer centers, according to one of the interviewees. After several years of growth, however, the same interviewee noted that local bus ridership on the west side has stagnated. Light rail ridership, on the other hand, has continued to grow vigorously, particularly in off-peak hours and in the reverse commute direction. This history suggests to the authors that demand for shorter local bus service running on 30 minute headways may be stagnating, while demand for more frequent service on long crosstown arterial roads with lots of commercial and retail activity may be increasing. This conclusion is clouded by the fact that reverse direction light rail ridership is dependent upon bus connections for patrons to reach jobs located at some distance from light rail stations. It could be that shuttle buses provided by local employers, as well as bicycles, are increasingly fulfilling this need.

The authors received further comments on the growth of off-peak ridership. One contact observed that LRT is doing well attracting off-peak riders. This contact says that most ridership growth on bus and rail is occurring during the off-peak. This contact pointed to residential development downtown (now 15,000 to 18,000 residential population) as generating new ridership markets. This same person pointed to employer-based pass programs as important ridership generators.

Another important ridership market is ridership to strip development along major arterials. One of the study's contacts noted Tri-Met gets large ridership on routes that serve strip commercial development. This contact pointed to a route on 82nd Avenue and another on Tualatin Highway as examples of routes that are successfully serving this market. The Tualatin Highway route is interesting because it parallels the LRT line. The contact noted that Tri-Met improved service on the route and gained riders as a result. This contact believes most of the ridership gain represents more use by existing riders, as opposed to the attraction of new users to transit.

Transit and Development

Portland is famous for its strong land use policies and for its coordination of land use policy and transportation investment. One of the interviewees specifically pointed to land use policy as an important factor in affecting ridership trends. This same interviewee characterized the recent interest in transit-oriented development (TOD) as emblematic of the larger concern about coordinating the two policy areas.

One interviewee spoke about the effects of TOD on ridership. This person characterized the effects as modest, largely due to the limited number of TODs that are in place in the region. This person sees more interest in TOD on the part of developers and feels that more TODs will be built in the region. Should that occur, this person feels more ridership will result.

The major land use change that occurred on the original light rail line during the first decade was transformation of Lloyd Center, on the east side of the Willamette River across from downtown Portland, from a dying mall (it was the first suburban mall in the region) into a complex activity center that became an extension of the downtown. There was a lot of proactive planning movement on the part of Portland to make this happen, but most observers think that the light rail line helped the effort to succeed.

For about a decade after the opening of the Banfield light rail line there was little to no new development around most other stations, even though zoning was favorable and the appropriate political jurisdictions were supportive. As planning began for the Westside line (to Hillsboro), Metro created new transit zoning codes that would disallow low-density development around transit stations. Metro also hired a developer with experience in moderate density residential construction to teach developers in the Portland region how to construct such units profitably. By 1998 there were a handful of high density apartment complexes and condos being constructed around outer Banfield stations.

The new light rail line to the west that opened in 1998 ran adjacent to large employers, and it served the timed transfer centers that opened in Cedar Hills and Beaverton in 1979. It also passed miles of greenfield sites slated for development that could be molded around transit. This was the area of Portland's most explosive employment growth (Silicon Forest), and it was a hot market for high end residential development, as well.

Even as the line was under construction, new medium density residential developments also started. New complexes were designed to support the rail stations. Some had commercial and retail space on ground floors, but the mix in uses was minimal, and the non-residential parts did not lease out quickly. On the other hand, the line directly served and came close to very large, high tech employers.

Public Attitude Toward Transit

Before the Banfield light rail line opened in 1986, Tri-Met had a very poor image in the region and had gone through two organizational shakeups even before it was allowed to think about building light rail.[199] During planning and construction, the bad image remained, even though Tri-Met now had a competent organization. When former Mayor Neil Goldschmidt ran for governor in 1986, he asked Tri-Met to delay the opening of the light rail line from Labor Day to after the election in November, because he was certain that the opening would be bungled and the line pilloried as a failure and a boondoggle. Tri-Met went ahead with the Labor Day opening, however, and in addition, restructured most of the bus routes on east side on the same day. Trains and buses on their new routes functioned flawlessly. The line was a hit with the public. From that day to this Tri-Met has been a favorite of Portland's political establishment.

The study's interviewees characterized the public attitude to transit today as very supportive. One contact pointed to a survey of riders that found 85–90% giving a good/excellent rating to transit. This same contact pointed to the state legislature as being very supportive of transit. They provided lottery money for the Westside LRT, and are contributing $250 million toward the local match for the Milwaukie LRT line. The interviewee noted the potential economic development effects of LRT appeal to state legislators and so does the ability to get federal-aid dollars.

There have been some stumbles along the way, most notably a failed election to fund a north-south LRT line. The contact noted it passed in Oregon but lost in Clark County, Washington. This scuttled the effort. However, the study's contacts report that there is more support for LRT in Clark County today than there was in the past.

DISCUSSION

Over the past 25 or so years, the Portland region's transit system has performed the best of the eleven metropolitan areas in this study. Riding habit consistently has improved as has service productivity. During this time rail went from accounting for none of the region's transit patronage to about 43% measured in passenger miles, which occurs on an LRT infrastructure of about 48 miles in length (including the streetcar). Rail now is the center piece of the Portland regional transit system and clearly plays a part in its success.

Attributes of the system that contribute to its success are several. These include:

1. Partial reorganization of the bus routes into a grid running on arterial roads with lots of activity, connecting with rail for access to the CBD and other major destinations;
2. Having the rail lines intersect with several of the grid bus routes as described above, two of these are the first and second most heavily patronized bus routes in the system;
3. In other parts of the city, reorganizing bus routes into timed transfer networks;
4. Routing the rail lines to "plug" into several such timed transfer centers;
5. Routing rail lines to serve sectors of the region that are rapidly growing in both employment and population;
6. Having regional planning and zoning policies in place, prohibiting low density, auto oriented activities near stations and encouraging high density activities in their place, thereby harnessing the market forces already extant in the high growth corridors to develop the land with dense land uses and transit access; and
7. Keeping regional rail services relatively fast. (However, the slow movement of trains through the central city is a problem here.)

Regional control of land use development appears to play a major role, as well. Apparently because of the growth boundary, the degree of employment decentralization is less than in other regions in this study, and most of such decentralization has occurred within the transit service area, in many instances relatively close to rail lines. Unlike some other regions in the study, such as Atlanta and Dallas, there are not large employment destinations in the Portland region that remain unserved by transit, and thus transit patronage is not depressed by unserved employment as it is in some other regions (see Figure 109). Similarly, population decentralization has occurred primarily within the transit service area. There are no other metropolitan regions close enough to Portland, with the exception of Vancouver, to lure employees within the region to residences outside of the region, a trend that appears to be depressing transit in some of the other study areas, such as San Diego.

There are areas of concern, particularly related to the intensifying CBD focus to the rail investments. Having the Interstate MAX line come downtown requires large investment to rebuild the transit mall that would have been unnecessary had that line remained on the east side of the river, where it would have served major employment concentrations that remain unserved by rail. The very slow speed of trains running through the downtown also mitigates against success in serving the demand of workers living on the east side of the region to reach jobs in the western part of the region. The strong CBD focus of the bus system is also an area of potential concern given the wide array of non-CBD travel destinations in the region.

Portland's CBD, while healthy, has not grown relative the regional employment, as has been the case in Miami and Denver. Yet, transit does better in Portland. Clearly, pro-downtown policies contribute to Portland's transit success but, as the case study indicates, they are not the only reason for it.

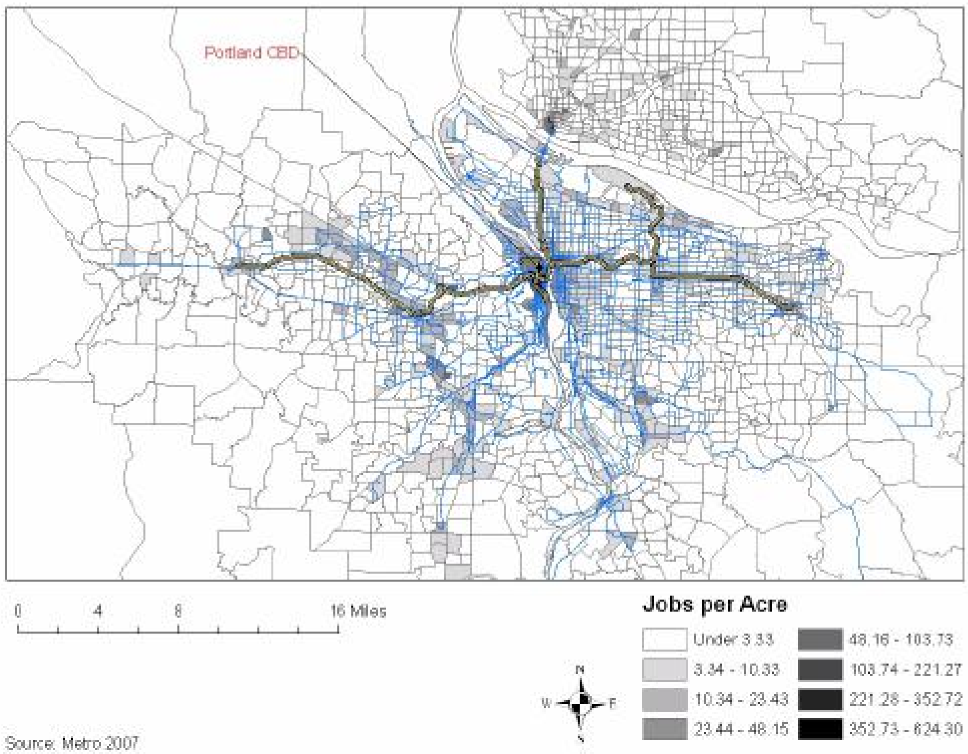


Figure 109 Tri-Met system in Portland and its relation to employment (2006)

APPENDIX H
SACRAMENTO, CALIFORNIA

SETTING

The Sacramento Metropolitan Statistical Area (MSA) consists of four counties in central California with a total land area of just under 5,100 square miles.[200] With just over 2 million persons in 2005, the Sacramento MSA ranks as the nation's 26th largest in population.[201] The Sacramento MSA's population density is just over 400 persons per square mile.

Sacramento County is the center of population and employment in the MSA (see Figure 110). Sacramento County is served by the Sacramento Regional Transit District (RT), the metropolitan area's largest transit agency. Smaller transit operators provide service in other parts of the MSA, as the authors note later in the case study.

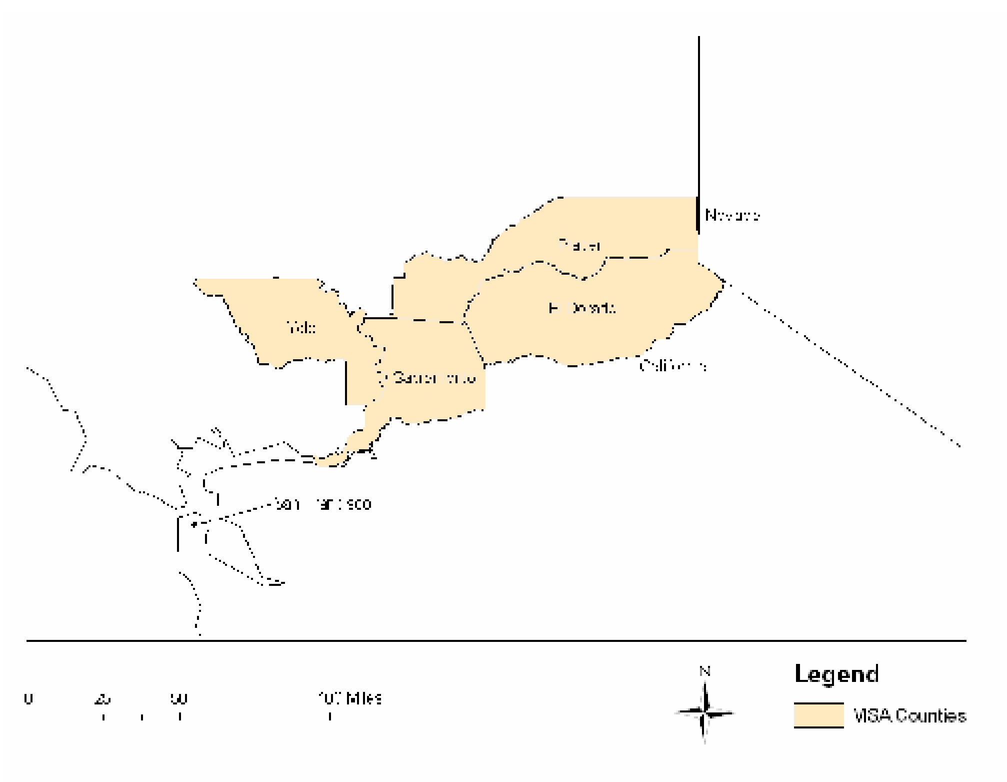


Figure 110 Sacramento metropolitan statistical area

Distribution of MSA Population

Sacramento is a growing metropolitan area. Population has increased and decentralized since 1970, as shown in Figure 111. This figure provides maps of population by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of population from Sacramento County at the center of the metropolitan area first to Placer County and then to Yolo and El Dorado Counties.

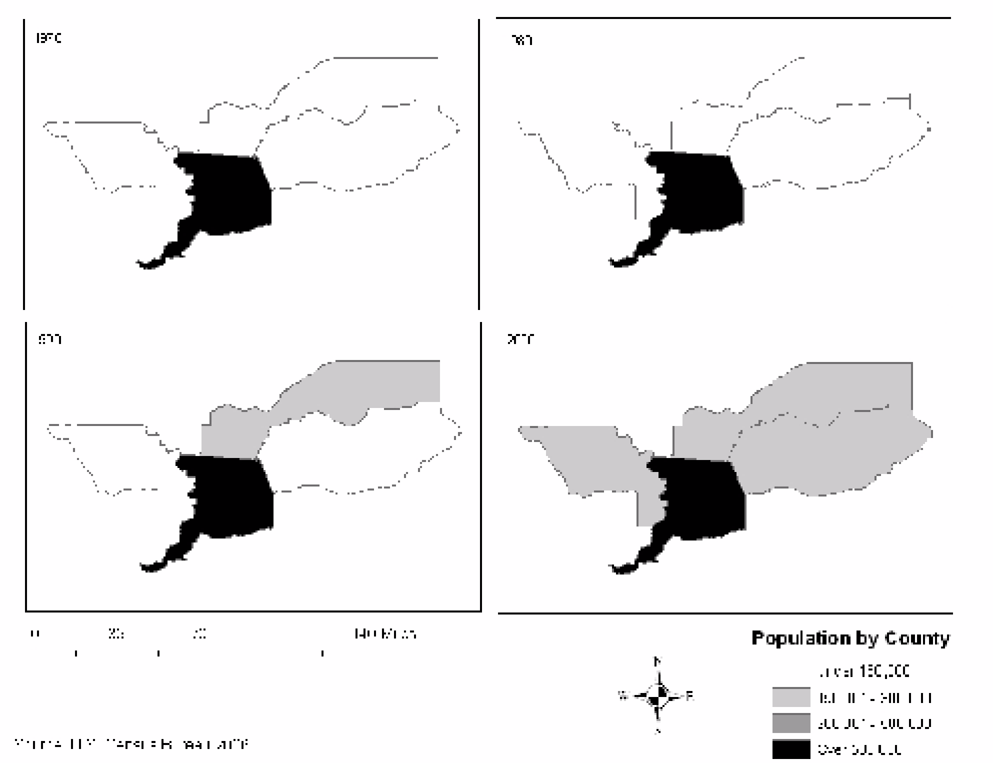


Figure 111 Sacramento MSA: population by county (1970–2000)

Between 1970 and 2005, total MSA population increased nearly 140% from 840,000 to just over 2 million persons (see Table 114). Population has grown rapidly in all four counties in the Sacramento metropolitan area. Population has grown faster in El Dorado, Placer, and Yolo Counties than in Sacramento County, with the result that while Sacramento County accounted for three-quarters of MSA population in 1970 it accounted for just over two-thirds of MSA population in 2005. Sacramento County population increased 115% between 1970 and 2005. Its 2005 population density is 1400 persons per square mile. The remaining three counties increased their combined population more than 200%. Their overall population density is 185 persons per square mile. The Sierra Nevada Mountains and sparsely populated forest areas occupy the eastern parts of both El Dorado and Placer Counties.

The authors were able to obtain more detailed population data for the MSA for 2001, the most recent year for which these data are available. Figure 112 provides a map of population density by regional analysis district (RAD), measured as persons per acre. (The authors were unable to obtain population data for smaller geographic units, despite requesting such data from the MPO.) The figure shows that population is clustered in the center of the region, particularly in Sacramento County and the nearby suburbs.

Table 114 Population in the Sacramento metropolitan area (1970–2005)

Year	Sacramento County	Other MSA Counties (3 counties)	Total MSA (4 counties)
1970	634,373	213,253	847,626
1971	653,800	222,200	876,000
1972	669,400	233,300	902,700
1973	669,900	235,900	905,800
1974	683,600	243,700	927,300
1975	697,400	251,500	948,900
1976	711,800	259,300	971,100
1977	727,600	272,500	1,000,100
1978	748,300	292,500	1,040,800
1979	768,500	303,100	1,071,600
1980	783,381	316,433	1,099,814
1981	806,297	327,049	1,133,346
1982	832,148	336,392	1,168,540
1983	852,626	341,367	1,193,993
1984	869,581	348,807	1,218,388
1985	891,113	359,651	1,250,764
1986	916,044	369,048	1,285,092
1987	948,523	382,741	1,331,264
1988	979,279	399,608	1,378,887
1989	1,008,753	419,738	1,428,491
1990	1,075,819	445,643	1,521,462
1991	1,107,559	459,435	1,566,994
1992	1,121,523	469,850	1,591,373
1993	1,127,608	480,466	1,608,074
1994	1,130,094	491,350	1,621,444
1995	1,140,825	504,273	1,645,098
1996	1,155,635	516,948	1,672,583
1997	1,169,855	530,633	1,700,488
1998	1,186,617	545,230	1,731,847
1999	1,206,659	560,578	1,767,237
2000	1,223,499	573,358	1,796,857
2001	1,266,243	600,886	1,867,129
2002	1,301,393	623,935	1,925,328
2003	1,330,377	644,441	1,974,818
2004	1,351,428	663,166	2,014,594
2005	1,363,482	678,801	2,042,283

Source: U.S. Census Bureau, 2007.

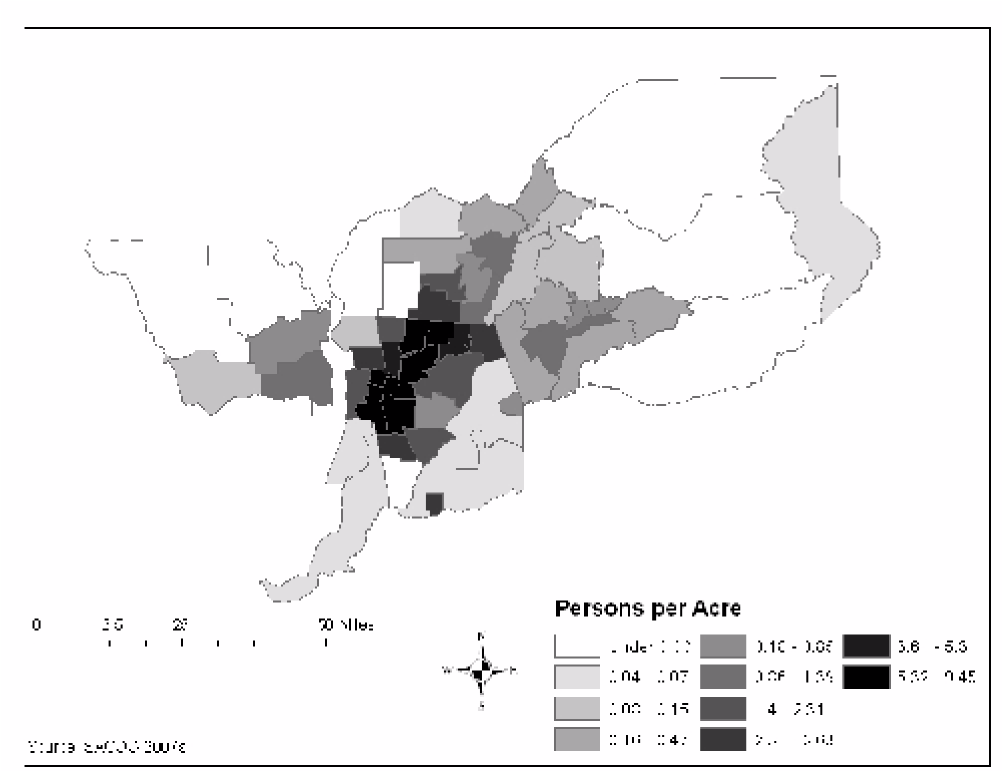


Figure 112 Sacramento MSA: population density by regional analysis district (2001)

Distribution of MSA Employment

Within the Sacramento metropolitan area, employment has grown and decentralized over the past several decades, but it remains much more concentrated than population. Figure 113 provides maps of employment by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of employment from Sacramento County to Placer and Yolo Counties.

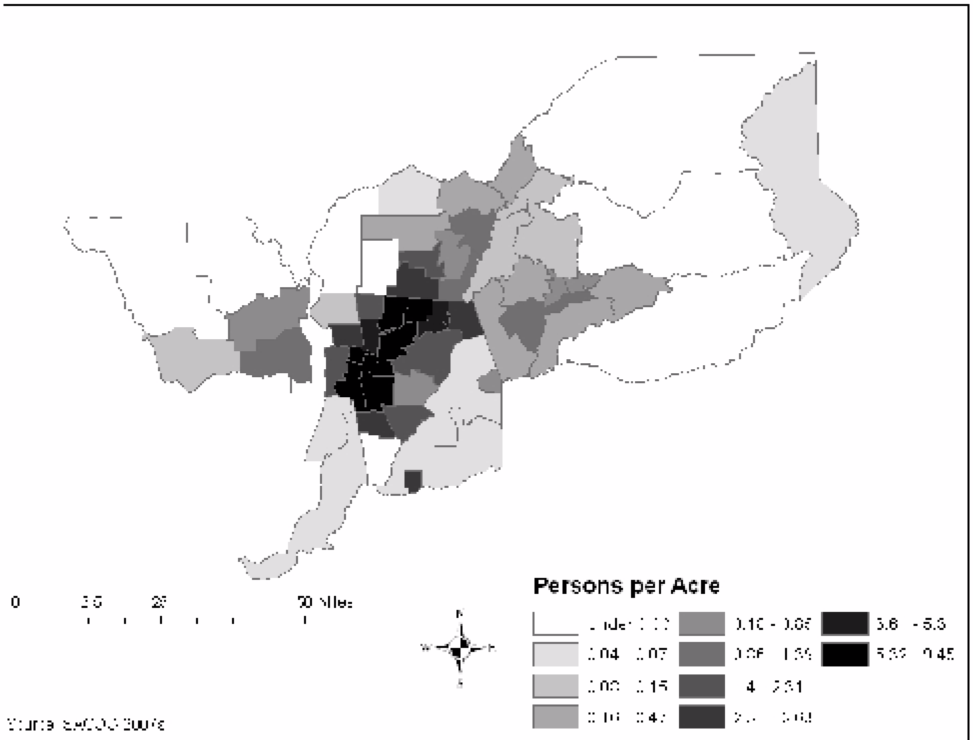


Figure 113 Sacramento MSA: employment by county (1970–2000)

Between 1970 and 2005, total MSA employment increased more than 230% from 360,000 jobs to nearly 1.2 million jobs (see Table 115). Employment growth outside Sacramento County (399%) exceeded employment growth inside Sacramento County (185%). The result is that, while Sacramento County accounted for 78% of total metropolitan employment in 1970, it accounted for 67% of total metropolitan employment in 2005. Employment growth inside Sacramento County has been faster inside the CBD (330%) than outside the CBD (177%). However, all of the CBD's employment growth occurred between 1970 and 1990. Since 1990, the Sacramento CBD has experienced declining employment.

The authors were able to obtain more detailed employment data for 1999 for the Sacramento MSA. Figure 114 shows employment density by regional analysis district (RAD), measured as the number of jobs per acre. (The authors were unable to obtain employment data for smaller geographic zones, despite requesting such data from the MPO.) The figure shows that the major employment clusters are in the core of the region and extend outward along Interstate 80 to the northeast and U.S. 50 to the east.

Table 115 Employment in the Sacramento metropolitan area (1970–2005)

Year	Sacramento County			Other MSA Counties (3 counties)	Total MSA (4 counties)
	Sacramento CBD	Outside CBD	Total		
1970	14,627	266,904	281,531	78,928	360,459
1971	15,420	271,272	286,692	81,828	368,520
1972	16,256	281,080	297,336	88,247	385,583
1973	17,137	288,978	306,115	94,524	400,639
1974	18,065	299,152	317,217	99,908	417,125
1975	19,045	307,509	326,554	105,444	431,998
1976	20,077	317,868	337,945	112,336	450,281
1977	21,165	331,873	353,038	118,667	471,705
1978	22,312	355,339	377,651	126,463	504,114
1979	23,521	374,336	397,857	135,515	533,372
1980	24,800	380,267	405,067	140,109	545,176
1981	27,446	390,099	417,545	141,982	559,527
1982	30,375	393,935	424,310	143,057	567,367
1983	33,616	404,735	438,351	149,797	588,148
1984	37,202	420,200	457,402	158,776	616,178
1985	41,172	446,938	488,110	164,582	652,692
1986	45,565	465,686	511,251	171,277	682,528
1987	50,427	489,796	540,223	182,977	723,200
1988	55,807	510,545	566,352	195,324	761,676
1989	61,762	528,916	590,678	206,376	797,054
1990	68,368	552,439	620,807	222,974	843,781
1991	68,006	550,834	618,840	233,216	852,056
1992	67,645	541,423	609,068	234,779	843,847
1993	67,287	533,471	600,758	241,734	842,492
1994	66,930	554,737	621,667	254,232	875,899
1995	66,575	562,811	629,386	263,103	892,489
1996	66,223	579,991	646,214	274,652	920,866
1997	65,872	594,687	660,559	283,998	944,557
1998	65,522	612,007	677,529	299,555	977,084
1999	65,175	643,108	708,283	317,289	1,025,572
2000	64,805	663,998	728,803	332,187	1,060,990
2001	64,462	683,154	747,616	351,575	1,099,191
2002	64,120	691,396	755,516	357,961	1,113,477
2003	63,780	700,765	764,545	370,413	1,134,958
2004	63,442	716,130	779,572	382,994	1,162,566
2005	63,106	738,126	801,232	393,530	1,194,762

Sources: U.S. Bureau of Economic Analysis 2007; U.S. Census Bureau 1970, 1980, 1990, 2000.

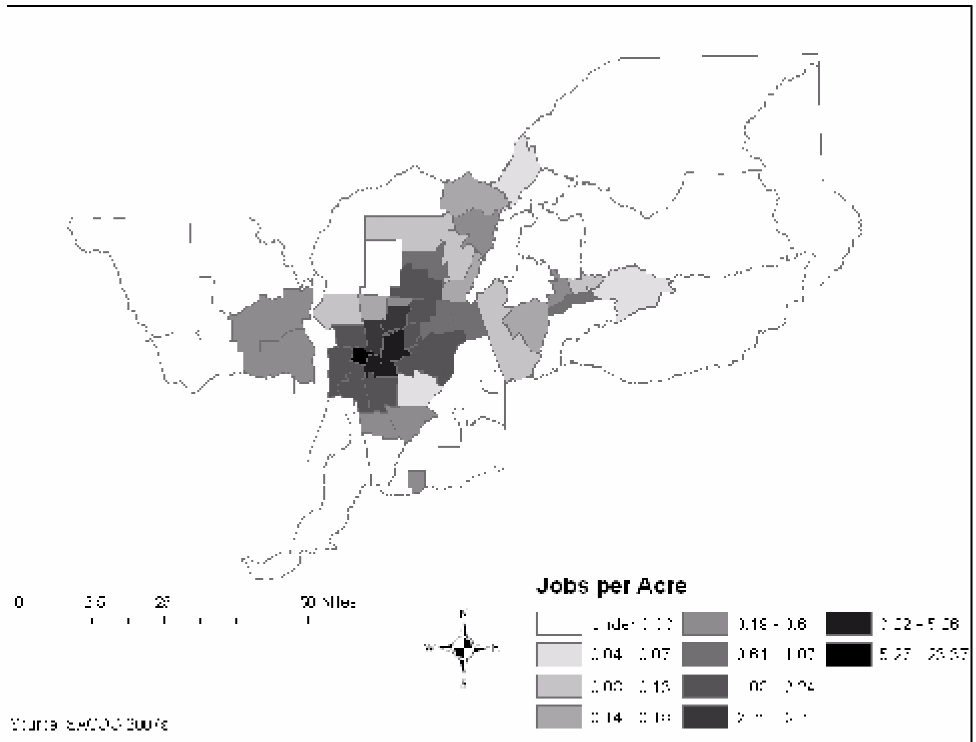


Figure 114 Sacramento MSA: employment density by regional analysis district (1999)

The Sacramento MSA clearly emerges from this brief examination of population and employment growth and distribution as a growing, decentralized metropolitan area. Both population and employment are decentralized, but there are a number of employment clusters and/or employment-rich corridors that appear, particularly in Figure 114. This pattern of potential travel destinations has clear implications for the structure of the transit systems in the region, as will be explored later in the case study discussion.

Institutions and Key Actors

The two organizations that play major roles in transit planning and policy in the Sacramento metropolitan area are the metropolitan planning organization, the Sacramento Area Council of Governments (SACOG), and the primary transit operator, Sacramento Regional Transit District (RT). One of the study's interviewees characterized these two organizations as having a good working relationship that evolved over time, particularly since SACOG became more interested in transit issues as opposed to just highway issues. As an example, this contact noted that SACOG helped RT trade sales tax-derived capital funds to Folsom (which wanted to build a highway bridge) in exchange for sales tax-derived operating funds that RT used to operate the south line LRT.

Sacramento Area Council of Governments (SACOG)

SACOG is the MPO for six counties in central California. In addition to the four-county Sacramento MSA, it includes Sutter and Yuba Counties. SACOG is governed by a 32-member appointed board made up of elected officials from the member jurisdictions. As the MPO for the Sacramento area, SACOG approves the short-range Transportation Improvement Program (TIP) and Long Range Transportation Plan (LRTP).

Sacramento Regional Transit District (RT)

RT is the primary transit operator in the Sacramento MSA. RT service is largely confined to Sacramento County. It is governed by an 11-member board made up of elected officials from its member jurisdictions. RT operates bus and light rail services.

Transit Agencies, Modes, Fares, and Rider Profiles

Four transit operators provide fixed-route service in the Sacramento MSA (see Figure 115). Three of these operators combined carry less than 5% of the metropolitan area's total ridership: Davis Unitrans, Roseville Transit, and Yolo County transit. The authors refer to these three agencies as the small transit agencies. The primary operator, RT, carries about 95% of all the metropolitan area's riders. The authors briefly discuss the small operators before providing a brief overview of RT's services, fares, and ridership profile.

Small Transit Agency Services, Fares, and Ridership

Davis Unitrans is a small operator that provides service in the city of Davis. Unitrans is operated jointly by the City of Davis and the University of California's Davis campus. Unitrans operates 14 regular routes and two routes that provide junior high and high school-focused service. The base fare is $1.00.[202] UC Davis undergraduate students, UC Davis parking permit holders, City of Davis employees, senior citizens, the disabled, and Medicare recipients ride free. UC Davis rides are funded through university student fees and other contributions. Unitrans provides free transfers for persons transferring from another operator to Unitrans. Figure 116 shows that Unitrans has experienced steadily increasing ridership since its inception.

Roseville Transit is a unit of the city of Roseville that operates local bus service in the Roseville area and commuter bus services to downtown Sacramento. Roseville Transit operates 12 fixed routes and a peak-period shuttle service. The adult base fare is $1.50.[203] Senior citizens, children, the disabled, and students pay discounted fares. Roseville Transit also sells day passes, monthly passes, and multi-ride passes. Transfers are free between Roseville Transit and RT, and between routes on Roseville Transit. Table 116 shows that ridership has increased steadily in recent years, largely as a function of increased service.

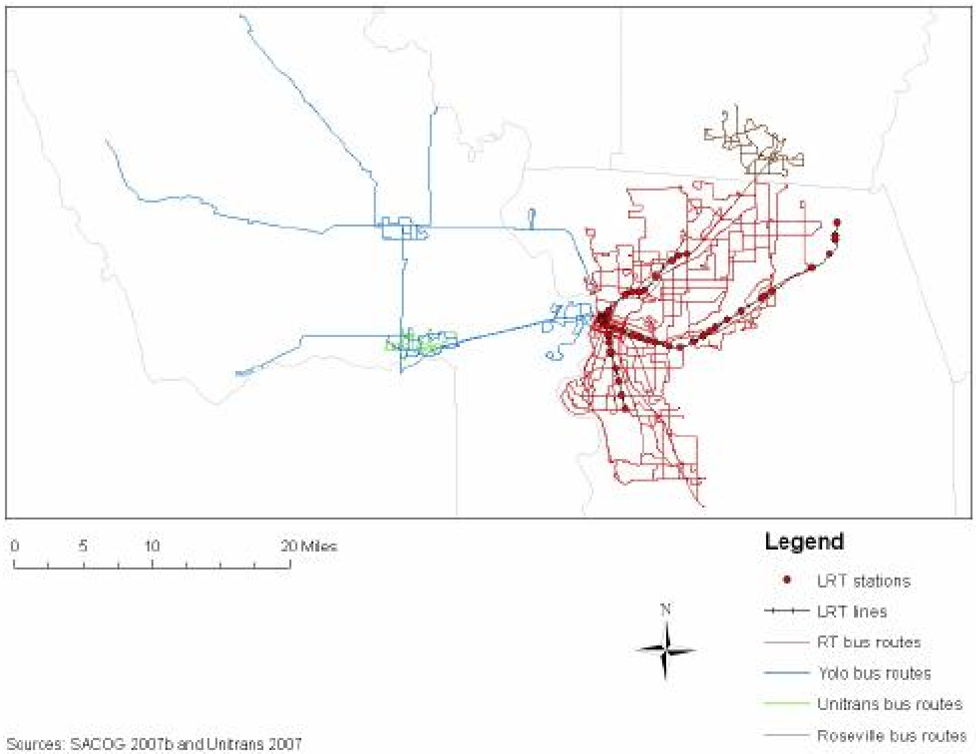


Figure 115 Transit systems in the Sacramento metropolitan area (2007)

Yolo County Transit (Yolo Bus) operates local and inter-city bus service in Yolo County and to Sacramento County. The local bus fare is $1.50 per ride, while the express fare is $2.00 per ride.[204] Students, senior citizens, and the disabled are eligible for discounted fares. Yolo Bus also sells daily and monthly passes. Transfers are free to other Yolo Bus routes, but are 75 cents for transfers to RT services. Table 116 shows that ridership increased steadily until the late 1990s when ridership spiked and eventually peaked. Ridership is down slightly in recent years.

RT Services, Fares, and Rider Profile

Sacramento Regional Transit District (RT) operates bus and light rail service in Sacramento County (see Figure 116). LRT service dates to the mid-1980s, but the system has been extended in recent years (see Table 117). The adult base fare for RT service is $2.00 per ride. Senior citizens, the disabled, students, and persons riding in the central city or on neighborhood services pay reduced fares.[205] RT also sells day passes, semi-monthly passes, monthly passes, and multi-trip tickets. The basic transfer charge is 25 cents, although groups eligible to pay reduced fares pay a reduced transfer fee.

In 2006, NuStats completed an on-board survey of Sacramento regional transit system users.[206] The results of the survey are reported in Table 118. These results suggest that most Sacramento RT riders are transit dependent persons. The table shows that the majority of riders are female and/or do not have a car available for their use. Most Sacramento transit riders reported low income levels, with over 40% earning $15,000 or less. Only 10% of riders reported a household income of $75,000 or more. One of the study's interviewees noted that RT appears to be losing choice riders, and thus becoming dominated by more transit-dependent riders, because it is increasingly difficult for riders to make transfers on RT's system. This difficulty tends to drive away riders who have other travel options available to them.

Table 116 Ridership on smaller Sacramento systems (1984–2004)

Year	Passenger Miles			Passenger Trips		
	Davis Unitrans	Roseville Transit	Yolo County Transit	Davis Unitrans	Roseville Transit	Yolo County Transit
1984			5,892,175			550,228
1985			5,353,050			513,612
1986			4,616,279			525,690
1987			5,397,494			511,492
1988			5,216,215			533,000
1989			5,840,755			562,231
1990			6,061,785			607,785
1991			6,260,445			642,919
1992	4,207,629		6,521,297	1,505,602		654,092
1993	4,153,992		5,919,464	1,600,702		570,617
1994	4,164,436		6,099,630	1,603,157		609,963
1995	4,588,316		6,106,344	1,764,737		640,685
1996	4,836,182		6,973,304	1,860,070		639,746
1997	5,422,822		7,003,564	2,085,809	184,620	688,647
1998	4,495,831	1,980,672	8,314,682	2,378,774	199,487	872,473
1999	4,425,766	2,151,680	14,051,509	2,341,618	280,832	950,711
2000	4,584,840	2,229,235	16,663,292	2,425,915	303,753	1,177,597
2001	4,648,090	2,241,180	18,625,261	2,459,307	315,684	1,260,156
2002	5,678,590	2,698,501	12,500,095	2,732,188	333,280	1,303,451
2003	6,526,929	2,616,632	11,976,788	3,142,492	326,906	1,248,883
2004	7,125,656	2,725,860	11,508,643	3,450,060	342,334	1,200,067

Source: Florida Department of Transportation, 2006.

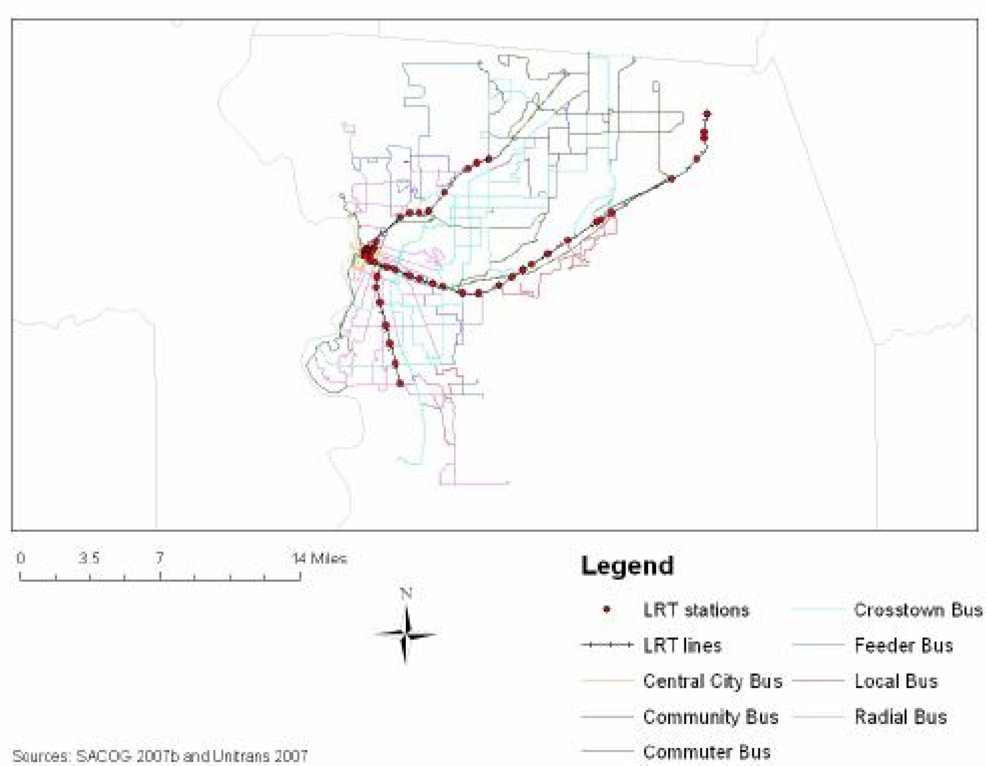


Figure 116 RT Transit System (2007)

Table 117 Sacramento light rail transit segment openings since 1987

Year	Segment Length (miles)	Line	Section	Cumulative System Length (miles)
1987	9.5	Northeast Line	Watt/I-80–13th Street	9.5
1987	8.8	East Line	13th Street–Butterfield	18.3
1998	2.3	East Line	Butterfield–Mather Field / Mills	20.6
2003	6.3	South Line	16th Street–Meadowview	26.9
2004	2.8	Folsom Line	Mather Field/Mills–Sunrise	29.7
2005	7.4	Folsom Line	Sunrise–Historic Folsom	37.1
2006	0.7	Amtrak/Folsom Corridor	St. Rose of Lima Park–Sacramento Valley Station	37.8

Source: Leroy Demery, *U.S. Urban Rail Transit Lines Opened from 1980*, October 18, 2005, 24.

Table 118 Demographics of RT riders

Survey Category	Response	Total Percent
Gender	Male	45
	Female	55
Vehicle Availability	Yes	43
	No	57
Household Vehicle Ownership	None	36
	One	29
	Two	19
	Three	9
	Four or more	7
Income	Under $10,000	31
	$10,000–$15,000	11
	$15,000–$30,000	20
	$30,000–$50,000	16
	$50,000–$75,000	12
	$75,000 or more	10

Source: NuStats, *On-Board Survey Results, Sacramento Region Transit Rider Survey*, Sacramento Area Council of Governments, September 2006, 29, 31, 37.

ANALYSIS

Regional Transit Vision and Its Evolution

The study's interviewees provided important insights into the Sacramento area's regional transit vision and its evolution.[207] One interviewee possesses knowledge of transit planning in Sacramento back to the 1970s, while the other's experience dates back to the late 1980s.

The passage of California's Transportation Development Act (TDA) in 1971 was a key event in the region's transit history. After TDA's passage, RT's focus was expanding bus service, and it doubled the amount of service it provided in a short amount of time, thereby exhausting the largess provided by the TDA. One of the contacts characterized the transit service structure at this time as primarily radial with some crosstown routes. RT operated significant express bus service during peak periods. Buses would run locally to pick up (or discharge) patrons and then run as express service on freeways to the Sacramento CBD. RT focused on service provision and skimped on maintenance and bus replacement, with the result that service reliability soon became an issue in Sacramento.

Between 1979 and 1981, RT planning director Bob Koski led a successful effort to reconfigure part of the system to a multi-destination timed transfer system with transit centers at the Florin Mall and Arden Fair shopping centers. This service restructuring, coupled with the energy crisis of 1979–80, led to large patronage increases just as the bus maintenance crisis came to a head. RT, in cooperation with SACOG's predecessor organization, developed a long-range plan that would have doubled service again, but its implementation depended upon passage of a sales tax measure, which because of the service crisis failed at the polls. Patronage fell for several years thereafter as the system fought to restore reliable service. During this crisis RT spun off its commuter services that crossed county lines to Yolo County and the City of Roseville.

Simultaneously, Sacramento explored rail transit development, first in the guise of an historic streetcar and later as LRT. Pro-rail advocacy groups such as the Modern Transit Society played important roles in advocating for LRT development. New RT management came on board with a plan to use LRT to improve transit system efficiency. General Manager Robert Nelson's vision was to replace CBD bus service with LRT and use the buses (as well as park and ride lots) to feed the LRT line. Subsequent general managers supported this initial vision for LRT's role in the system.

San Diego's successful development of a low-cost LRT system inspired Sacramento. RT looked for a proven technology and simple approach to LRT development. They built their starter LRT line with the concept that single track alignment works fine and that you double track only where trains pass. Rather than spend money double tracking, they extended the line further out. One of the interviewees expressed amazement at the kinds of areas where LRT operated, noting a warehouse district as an example of the kind of development through which the LRT traveled while carrying sizeable patronage. In 1988–1989, RT restructured more of the bus system into a multidestination timed-transfer system. Buses were restructured to feed rail at key rail stations.

Most suburban bus routes in the northern sector of the region were put on a "clock" 30-minute headway, and in one case, 15-minute headway. A clock headway means that the buses come by a stop the same number of minutes past the hour throughout the day. The clock headway bus routes were timed to meet with each other in both directions, and with trains going in both directions, at several transit center stations. These included the terminal stations and a couple of intermediate stations. The coordination of bus and rail services was successful. System patronage had been falling before the two legs of the light rail line opened, and it continued falling after they opened. When the coordinated bus service started in 1989, however, system patronage and productivity began climbing.

The authors' two contacts disagree on the extent to which RT has remained committed to the multidestination approach. One contact said without a strong advocate inside the transit agency multidestination became less of a focus. This contact noted one period when RT examined route performance and found that downtown-oriented routes performed better than suburban or outer routes. The interviewee thinks service on these routes degraded over time while radial routes improved. This same contact reported that RT's commitment to timed-transfers has also deteriorated. The contact gave an example of one place where bus routes came together at LRT and how the timed-transfer collapsed from having buses arrive when LRT did to having it arrive between LRT arrivals. This led to passenger waiting at the stop.

The contact also noted backsliding from the concept of clock headways. This shift occurred in 2004. Now buses on many routes come by stops at one set of times past the hour in the morning hours, and at a different time past the hour in the evening hours. On some other routes, headways have been changed to odd intervals, such as every 34 minutes, which makes it impossible to create timed transfers anywhere.

The study's other contact does not think they drifted away from the multidestination approach, but merely adjusted slightly. This contact says RT is still committed to using buses to feed rail, but noted that where they are able to operate buses on 15 minute headways, for example, they do not time transfer to rail. They split the headways. This creates longer transfer time, but allows more time for passengers to reach the platform and thus increases reliability of buses making the connection. In other circumstances, they still operate on timed-transfer system.

Regional Transit System Structure and Function

The LRT system provides what has been and could still be a skeleton for the larger transit system, but it suffers from some notable handicaps. One of the most notable handicaps is the lack of connecting bus service to the end of the LRT line in Folsom. Folsom is a major employment center in the region, and could become a major travel destination for LRT riders. One contact observed that if they had good bus service connections they would see significant ridership increases in the reverse commute direction in this area. This contact sees money as one obstacle. Folsom contributes $1 million per year to run the LRT trains, and they have their own bus service as well. However, they are not part of the annexed district, so RT doesn't allocate money to their (Folsom's) bus service or provide RT bus service in the area. The LRT itself does not run after 7 p.m. in the Folsom area.

The study's other contact also sees the failure to leverage the Folsom LRT investment as both an institutional and financial issue. In response to a question about the purpose of this LRT extension, this contact reported that it was promoted by the locals. They spoke about using LRT to access employment but did not provide the bus connections to reach the employment. This contact laments that RT is probably missing a lot of ridership because of the lack of service. The other contact says there are conversations with Folsom to allow higher coordination and more control of services without a large increase in operating costs. Folsom presently operates a lot of shuttle-type bus service.

Transfers

Sacramento RT possesses limited data on transfer activity. According to RT staff, among all RT riders, 60% indicated that they transfer at some point during their trip. Those interviewed on bus were somewhat more likely to transfer (64%) than those interviewed on rail (54%).[208]

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

The authors examined riding habit (passenger miles per capita) and service productivity (measured as passenger miles per vehicle mile, or load factor) for Sacramento transit systems from 1984 to 2004. Figure 117 provides the riding habit trend over this period. Noted on the graph are important events related to transit structure or fare policy that the authors suspect might be related to riding habit or service productivity change. The figure shows that riding habit declined over the period, but that the general slight downward trend encompasses an intermediate upward trend. This latter trend began with the bus route restructuring and service expansion that occurred in 1989, a couple of years after the light rail line opened in 1987. The riding habit increase was interrupted by a fare increase in 1992 but resumed, reaching a peak about 1999. From 1990 to 1997 neither bus nor rail service expanded, but ridership continued to increase faster than population from year to year.

Beginning in 1997, RT began to expand both bus and rail service. Service expansion continued through 2004. Despite the service expansion, riding habit peaked in 1999 and then declined sharply through 2002; it then remained at the lower 2002 rate during 2003 and 2004. The addition of light rail extensions (6.3 miles to the south, and the first 2.8 miles in the Folsom direction) in 2003 and 2004 did not stimulate an increase in riding habit, nor has continued expansion of bus service during these years.

Figure 118 provides a similar plot of service productivity, also overlaid with important events that might influence productivity. The graphic shows that productivity has declined since 1984, but has experienced peaks and troughs that correspond with service and fare changes. Productivity increased markedly during the mid-1990s as both bus and rail service remained relatively flat, but patronage continued to grow substantially from year to year. Bus and rail service began increasing in 1998 and continued to increase substantially through 2004. Unfortunately, after a couple years of additional growth, ridership failed to keep up with service expansion. At its peak in 1999, productivity stood almost at the same level as in 1984. Since then it has declined markedly, reflecting the fact that the major bus and rail service expansions that RT commenced in 1997 have failed to produce additional ridership commensurate with the added service.

RT System Ridership and Productivity Trends

Sacramento RT has experienced increasing overall ridership between 1984 and 2004 (measured on either on a passenger miles or unlinked passenger trips basis). Table 119 reports ridership by mode and for RT as a whole. The table shows that bus ridership has declined on a passenger miles basis (26%) but increased on an unlinked passenger trip basis (22%). The difference between the two trends is explained by the declining average trip lengths of bus patrons shown in Table 120. RT is carrying more shorter-distance bus passengers than it did in the past. The restructuring of the system in the late 1980s and as LRT came online may, at least partially, explain this downward trend in average trip lengths.

Rail ridership has increased dramatically since the first LRT line opened. Increased ridership tends to parallel system extension reported in Table 117. Average rail trip lengths have declined slightly since 1987, but have fluctuated in recent years. Average trip lengths by all RT patrons have declined significantly since 1984.

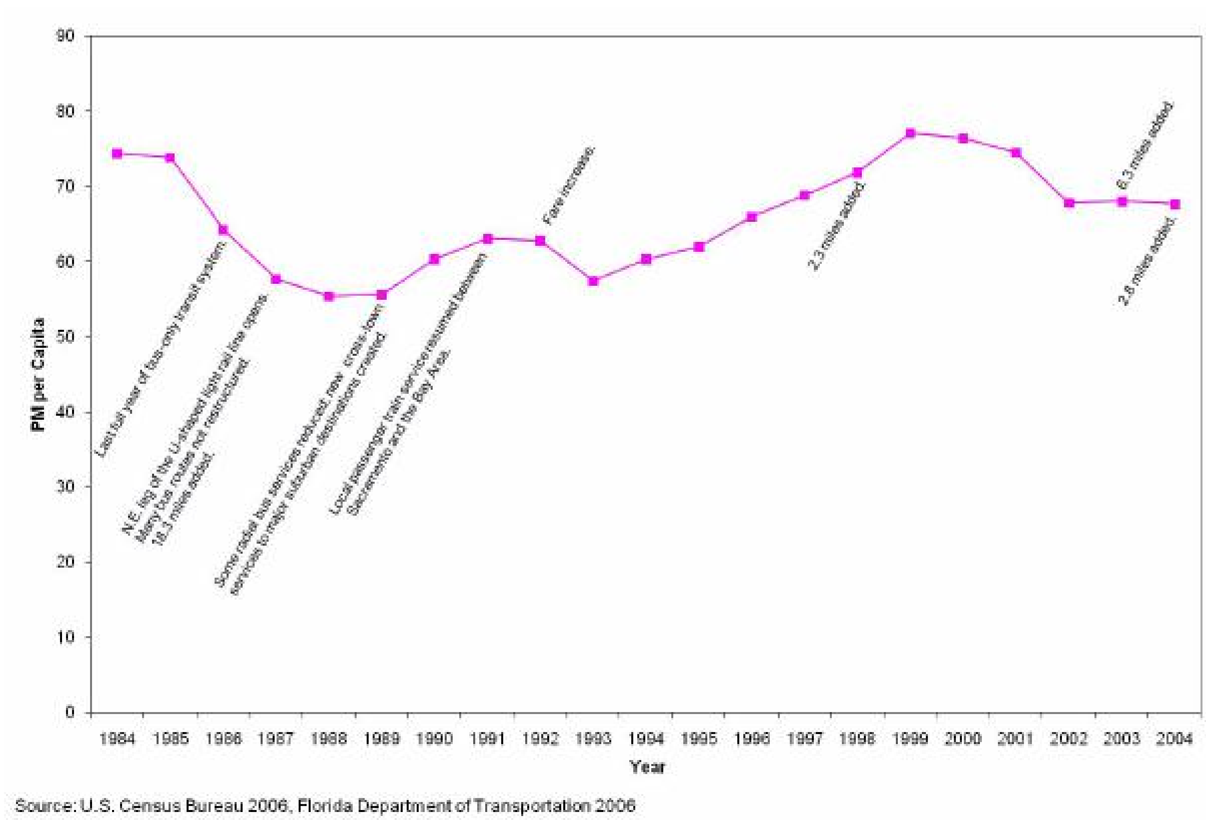


Figure 117 Sacramento MSA riding habit (passenger miles per capita) (1984–2000)

Table 119 Ridership on RT fixed route transit services (1984–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	RT Bus	RT Rail	RT Total	RT Bus	RT Rail	RT Total
1984	91,019,430		91,019,430	16,003,500		16,003,500
1985	93,472,737		93,472,737	16,051,068		16,051,068
1986	83,861,544		83,861,544	15,267,829		15,267,829
1987	73,321,618	3,523,766	76,845,384	13,165,436	610,788	13,776,224
1988	56,319,073	20,381,701	76,700,774	12,693,922	3,581,621	16,275,543
1989	57,786,349	21,633,715	79,420,064	12,959,589	4,010,752	16,970,341
1990	61,462,330	30,783,073	92,245,403	14,004,244	5,702,520	19,706,764
1991	66,108,661	33,564,588	99,673,249	16,133,088	6,592,504	22,725,592
1992	63,182,666	33,325,839	96,508,505	15,803,875	6,781,165	22,585,040
1993	57,532,184	31,507,873	89,040,057	14,519,401	6,571,393	21,090,794
1994	61,517,570	33,287,467	94,805,037	15,974,827	6,958,332	22,933,159
1995	65,461,391	33,547,547	99,008,938	16,024,587	7,063,657	23,088,244

Table 119 Ridership on RT fixed route transit services (1984–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	RT Bus	RT Rail	RT Total	RT Bus	RT Rail	RT Total
1996	69,428,949	37,342,569	106,771,518	17,147,987	7,654,443	24,802,430
1997	74,965,289	38,393,216	113,358,505	18,431,474	7,862,005	26,293,479
1998	79,510,385	39,425,446	118,935,831	19,682,218	8,074,880	27,757,098
1999	80,218,161	45,530,928	125,749,089	20,085,716	8,506,940	28,592,656
2000	79,145,237	45,867,205	125,012,442	19,493,371	8,626,868	28,120,239
2000	79,274,962	44,456,532	123,731,494	19,115,291	8,618,371	27,733,662
2002	72,297,460	46,710,911	119,008,371	18,068,907	8,541,086	26,609,993
2003	75,325,461	47,364,860	122,690,321	19,756,481	8,859,032	28,615,513
2004	67,700,922	56,948,051	124,648,973	19,446,782	11,022,004	30,468,786

Source: Florida Department of Transportation, 2006.

Table 120 Average trip lengths (RT) (1984–2004)

Year	Average Trip Length (miles)		
	RT Bus	RT Rail	RT Total
1984	5.69		5.69
1985	5.82		5.82
1986	5.49		5.49
1987	5.57	5.77	5.58
1988	4.44	5.69	4.71
1989	4.46	5.39	4.68
1990	4.39	5.40	4.68
1991	4.10	5.09	4.39
1992	4.00	4.91	4.27
1993	3.96	4.79	4.22
1994	3.85	4.78	4.13
1995	4.09	4.75	4.29
1996	4.05	4.88	4.30
1997	4.07	4.88	4.31
1998	4.04	4.88	4.28
1999	3.99	5.35	4.40
2000	4.06	5.32	4.45
2001	4.15	5.16	4.46
2002	4.00	5.47	4.47
2003	3.81	5.35	4.29
2004	3.48	5.17	4.09

Source: Florida Department of Transportation, 2006.

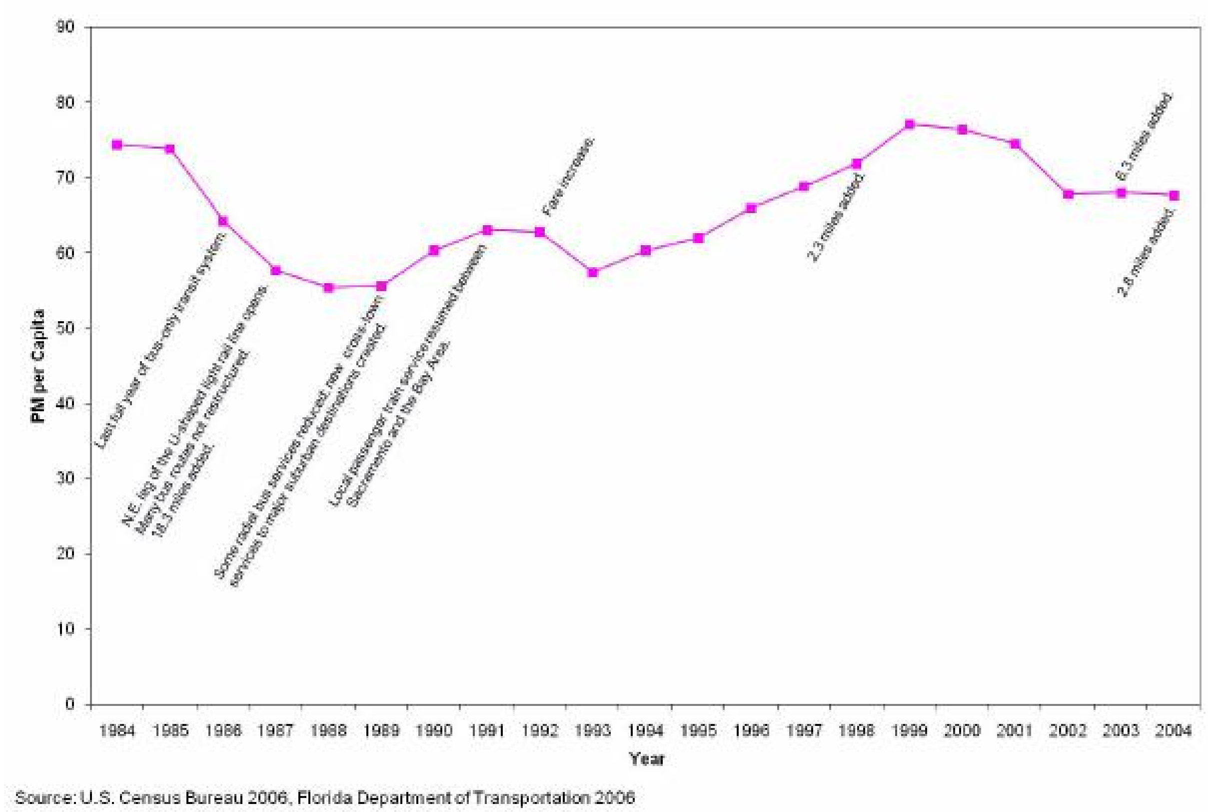


Figure 118 Sacramento MSA: load factor (passenger miles per vehicle) (1984-2004)

Table 121 reports the amount of transit service provided by RT between 1984 and 2004, by mode. The table shows that bus service declined during the mid-to-late 1980s, fluctuated between 7.8 and 8.3 million vehicle miles during the early to mid-1990s, and began to increase in the late 1990s. RT provided about 25% more bus service in 2004 than it did in 1984. Rail service has increased, particularly since the late 1980s, as new segments of the LRT have opened.

Table 122 relates the ridership information reported in Table 119 with the service information presented in Table 121 to measure service productivity. As a service productivity measure, the authors used passenger miles per vehicle mile, or load factor. The table indicates that bus service increases have outpaced ridership gains, resulting in diminished bus service productivity. Bus service productivity declined until the mid-1990s when it increased prior to its most recent decline. Rail service productivity has been more stable, although it too has fluctuated from year to year.

Table 121 RT fixed route transit service (1984–2004)

Year	Vehicle Miles		
	RT Bus	RT Rail	RT Total
1984	8,006,991		8,006,991
1985	7,922,932		7,922,932
1986	8,085,996		8,085,996
1987	7,838,051	244,923	8,082,974
1988	7,169,948	961,523	8,131,471
1989	7,033,374	1,083,527	8,116,901
1990	7,785,910	1,460,621	9,246,531
1991	8,082,351	1,511,868	9,594,219
1992	8,092,387	1,701,245	9,793,632
1993	8,297,772	1,692,621	9,990,393
1994	8,050,270	1,839,387	9,889,657
1995	7,858,695	1,801,539	9,660,234
1996	7,894,976	1,848,543	9,743,519
1997	8,113,957	1,910,015	10,023,972
1998	8,382,039	1,910,066	10,292,105
1999	8,592,616	2,192,813	10,785,429
2000	8,845,464	2,267,721	11,113,185
2001	9,094,687	2,182,503	11,277,190
2002	9,248,892	2,167,092	11,415,984
2003	9,462,977	2,198,090	11,661,067
2004	10,154,665	2,938,825	13,093,490

Source: Florida Department of Transportation, 2006.

Table 122 RT service productivity (1984–2004)

Year	RT Bus	RT Rail	RT Total
1984	11.37		11.37
1985	11.80		11.80
1986	10.37		10.37
1987	9.35	14.39	9.51
1988	7.85	21.20	9.43
1989	8.22	19.97	9.78
1990	7.89	21.08	9.98
1991	8.18	22.20	10.39
1992	7.81	19.59	9.85
1993	6.93	18.61	8.91
1994	7.64	18.10	9.59
1995	8.33	18.62	10.25
1996	8.79	20.20	10.96
1997	9.24	20.10	11.31
1998	9.49	20.64	11.56

Table 122 RT service productivity (1984–2004)

Year	RT Bus	RT Rail	RT Total
1999	9.34	20.76	11.66
2000	8.95	20.23	11.25
2001	8.72	20.37	10.97
2002	7.82	21.55	10.42
2003	7.96	21.55	10.52
2004	6.67	19.38	9.52

Source: Florida Department of Transportation, 2006.

Bus Route Performance Analysis

The authors took a more detailed look at transit system performance by examining the performance of bus routes serving different functions or markets in the transit system. They obtained route-based ridership (unlinked passenger trips, or boardings) and service (revenue hours and revenue miles) for the average weekday, Saturday, and Sunday. Using these data, they constructed two measures of route performance: boardings per revenue hour and boardings per revenue mile.

In exploring differences among bus routes, the authors distinguished between routes that serve the Sacramento CBD and those that do not. They also classified the routes using the classification scheme RT uses for its routes. RT differentiates between central city, community, feeder, local, commuter, crosstown, and radial routes. Table 123 presents the results of the study's analysis of route performance. The data in the table refer to the median route within each type of route.

The table indicates that the median CBD-serving route outperforms its non-CBD counterpart, but not by a lot. The 15 crosstown bus routes, all but one of which does not serve the CBD, are the strongest performers. These are followed by radial routes, and then by the commuter routes. The poorest performing routes are the community bus routes, which perform a circulator function in neighborhoods.

Table 123 RT bus route performance

Route Type	Routes	Boardings per Revenue Hour (median route)			Boardings per Revenue Mile (median route)		
		Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
All bus routes	77	24.40	18.63	19.36	2.12	1.60	1.69
All CBD-serving bus routes	26	26.09	21.24	19.96	2.24	2.01	1.72
All non-CBD bus routes	51	22.94	18.50	18.12	1.94	1.55	1.67
All central city bus routes (CBD)	4	13.78	3.68	n.a.	2.01	0.61	n.a.
All community bus routes (non-CBD)	9	7.03	6.01	n.a.	0.61	0.54	n.a.
All feeder bus routes (non-CBD)	11	22.03	19.91	16.34	2.15	1.55	1.33
All local bus routes (non-CBD)	6	23.31	12.63	20.22	3.36	1.57	1.72
All commuter bus routes	14	22.55	n.a.	n.a.	1.87	n.a.	n.a.
All CBD-serving commuter bus routes	5	29.02	n.a.	n.a.	1.87	n.a.	n.a.

Table 123 RT bus route performance

Route Type	Routes	Boardings per Revenue Hour (median route)			Boardings per Revenue Mile (median route)		
		Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
All non-CBD commuter bus routes	9	21.36	n.a.	n.a.	1.23	n.a.	n.a.
All crosstown bus routes	15	27.16	22.74	21.80	2.29	1.84	1.83
All CBD-serving crosstown bus routes	1	33.54	26.68	26.67	3.79	2.17	2.03
All non-CBD crosstown bus routes	14	26.82	22.36	21.62	2.27	1.78	1.77
All radial bus routes	18	26.31	21.24	19.91	2.47	2.01	1.65
All CBD-serving radial bus routes	16	26.09	21.24	19.91	2.41	2.01	1.65
All non-CBD radial bus routes	2	32.26	20.94	15.70	2.86	1.91	1.43

Source: Sacramento Regional Transit District, 2007b.

RT has invested heavily in such routes in order to serve unincorporated areas that might otherwise elect to incorporate and form their own transit agencies, which would receive a portion of the Sacramento area's TDA funds. In Elk Grove, a southern suburb, a community incorporated, created its own transit service, and replaced a relatively productive set of all-day local and express bus routes that operated on timed transfer with neighborhood-based peak-period express routes to the CBD with much lower productivity. This process that happened in Elk Grove is exactly the opposite of the process that happened in the western part of the Portland metropolitan area in 1979 (see Appendix G, Portland Case Study). Unfortunately, RT's strategy to retain these areas, and their TDA funds, has led to the proliferation of low-performing community bus routes throughout the RT system.

Rail Station Entries

RT supplied the authors with data showing the number of passengers alighting at stations during the weekday morning peak. They categorized LRT stations as serving the downtown or serving other areas. Stations located in the downtown are contained in the red circle shown on the LRT system map in Figure 119. They then tabulated the station-specific alighting data for both the Blue Line and Gold Line, and differentiated between downtown, north suburban, and south suburban stations. The authors also identified the major transfer point at the 16th Street Station. Table 124 provides alighting data for the Blue Line, while Table 125 provides the same data for the Gold Line. Combined, the two tables show that during the morning peak, roughly one third of the rail system passengers alight from trains at downtown stations, and roughly two thirds alight from stations in other areas. Thus, during the morning peak, roughly two-thirds of RT light rail users are destined to places other than the downtown.

Half of this latter number, that is one-third of morning peak period light rail passengers, alight at stations in the central area of Sacramento but outside the downtown. Many of these are passengers transferring between the two light rail lines at the 16th Street Station, which has the largest number of passenger boardings and alightings for both lines of any station on the system. (The authors were told that there is not much reason to board or alight from this station unless one is transferring between the two lines. The station is located in an industrial area.) Many Gold Line passengers board inbound light rail trains in the morning and transfer to southbound Blue Line trains at the 16th Street Station. Many of these passengers are bound for City College. Similarly, many Blue Line morning peak period passengers board northbound Blue Line trains in the morning and transfer to outbound Gold Line trains at the 16th Street Station. Many of these passengers are bound for California State University Sacramento.

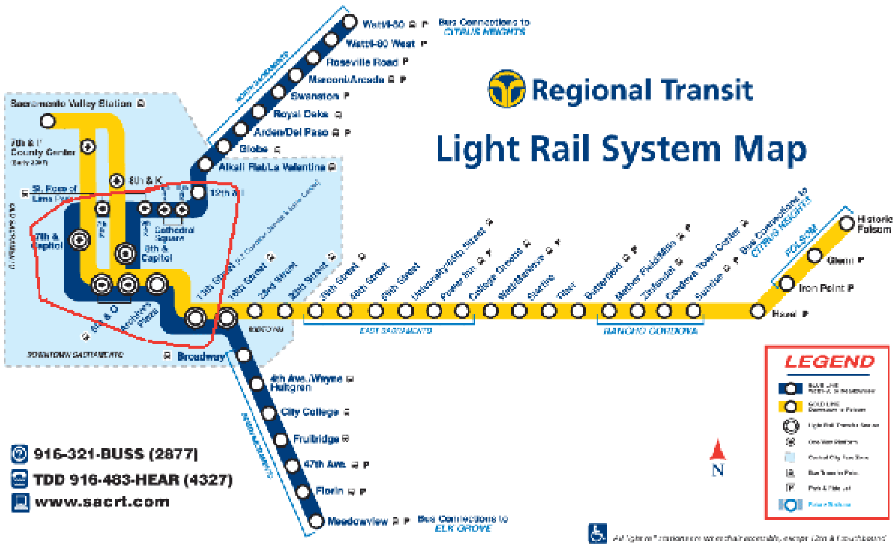


Figure 119 Sacramento light rail transit system (2007)

The other one-third of the morning peak period light rail passengers alight from trains farther out on the two legs of the Blue Line and the one leg of the Gold Line. It is unknown what type of destinations these passengers ultimately reach, nor how they reach those destinations, but presumably many do so by bus connections. At one time there were transfer centers at Watt/I-80 and Arden/Del Paso on the north end of what is now the Blue Line, and at 65th/University and Watt/Manlove on what is now the Gold Line. Buses still meet trains at these locations, but as noted elsewhere, RT no longer times buses that are on 15 minute headways with the trains or presumably with each other.

Other buses are timed with trains, but it is unclear as to whether the timed connections work in both directions for both the buses and trains as in earlier years. There do not appear to be established bus transit centers on the south leg of the Blue Line, which opened in 2003, nor on the extension of the Gold Line through Rancho Cordova to Folsom, which opened in phases through 2006. There are buses on arterial roads that both extensions cross, and these buses call at the stations. One of the contacts states that the buses if on 30 minute headways or longer, make timed connections with trains, but whether in both directions is unclear. RT's system map indicates a list of transit centers, but none of these are located at rail stations. Still, as reported earlier, the RT system wide transfer rate is thought to be above 60%. Although the transfer rate is lower for trains, presumably many rail patrons destined to suburban stations in the morning peak period use RT buses to reach their final destination.

Table 124 RT Blue Line weekday a.m. peak alightings

Downtown Stations		North Suburban Stations	
Station	**Alightings**	**Station**	**Alightings**
12th & I Streets	310	Alklali Flat/La Valentina	318
13th Street	103	Arden/Del Paso	222
7th/8th & Capitol	314	Globe Avenue	85
8th & O Streets	384	Marconi/Arcade	122
Archives Plaza	281	Roseville Road	18
Cathedral Square	510	Royal Oaks	59
St. Rose of Lima Park	536	Swanston	26
		Watt/I-90	322
		Watt I-90 West	0
Subtotal	**2,336 (35.79% of alightings)**		**1,172 (17.95% of alightings)**
South Suburban Stations			
16th Street Transfer Station	702		
47th Avenue	81		
4th/Wayne Hultgren	174		
Broadway	329		
City College	787		
Florin	310		
Fruitridge	118		
Meadowview	414		
Subtotal	**3,019 (46.26% of alightings)**		
TOTAL ALL STATIONS		**6,527**	**100.00%**

Table 125 RT Gold Line weekday a.m. peak alightings

Downtown Stations		Other Stations	
Station	**Alightings**	**Station**	**Alightings**
7th & I/8th & K	803	16th Street—Transfer Station	751
7th/8th & Capitol	334	13th Street	101
8th & O Streets	580	23rd Street	149
Archives Plaza	565	29th Street	492
Sac Valley	195	39th Street	90
Subtotal	**2,477 (39.14% of alightings)**	48th Street	42
		59th Street	112
		65th Street	348
		Butterfield	280
		College Greens	152
		Cordova Town Center	59
		Glenn	54
		Hazel	37
		Historic Folsom	67
		Iron Point	67
		Mather Field/Mills	246
		Power Inn Road	201
		Starfire	37
		Sunrise	199
		Tiber	56
		Watt/Manlove	207
		Zinfandel	103
		Subtotal	**3,851 (60.85% of alightings)**
TOTAL ALL STATIONS		**6,329**	**100%**

The tables also show that there is one set of stations where few passengers alight during the morning peak period. These are the four stations beyond Sunrise on the new light rail extension to Folsom. As noted earlier, some of these stations lack connecting bus service, and what service there is, in Folsom itself, tends to be poor. Some of these stations appear to be proximate to large employers. This is anecdotal, in that the study's contacts and others familiar with the region state that large employers are located in the area. The authors were unable to check this assertion, however, because SACOG has been unable to supply them with employment data at the traffic analysis zone level. If there indeed are large employers near the stations, the fact is that almost none of the employees or customers use RT to reach this employment, in contrast, for example, to the large usage to outer suburban employers that Tri-Met enjoys on its Westside light rail extension to Hillsboro. It is unknown why the

Folsom light rail line is failing to tap this market. Whatever its cause, the failure contributes to the low productivity of this major transit investment.

Emerging and Declining Ridership Markets

The authors asked the study's interviewees about several specific ridership markets that had been considered important ridership targets at the time RT embraced the multidestination service structure in the late 1980s.[209] One of these markets was a strip arterial environment served by a long route, Route 1. This route was implemented with 15-minute headways (a frequency of service unprecedented in the outer suburbs of Sacramento, where 60-minute midday headways had been the norm) in 1989 to connect the then two outer terminals of the two light rail lines by way of lengthy strip malls and the largest regional mall in the Sacramento Valley. From the time it was implemented, route 1 enjoyed the largest patronage of any bus route in the RT system, but its passenger boardings per hour were only at the median level for the system.

In 2004, this route was split into two separate routes. One of the study's interviewees observed that many people inside RT viewed the former Route 1 as wasteful because a lot of service was dedicated to this route. This contact observed that the piece that is still classified as Route 1 has high density housing and the right socioeconomic mix for transit, and that it connects people to a major mall. This segment required a lot more service than the next segment of the route. This segment now operates with 15-minute headways during the peak period but 20 minutes during the base period, which makes it impossible to have timed connections with bus routes or trains operating on 15 minute or 30 minute headways. After that segment, the route entered a more transit-oriented area again.

The study's contact believes the two transit oriented areas generated most of the earlier route's ridership. When the Mathers Field LRT extension opened, the route was restructured to terminate there, and the most productive part of the route was lopped off. Then, rather than running service duplicative of the LRT line, RT decided to run two different bus routes to fill in the gap between the Mather and Butterfield LRT Stations. The authors' contact notes that neither route is as productive as the original one. This type of decision is reflective of a particular mindset about bus service planning that the authors suspect influenced bus planning decisions prior to the changes made in 2004, and might have occurred simultaneously with the productivity declines shown earlier in Figure 118.

As part of development for the South Line LRT, one contact observes that there has been bus restructuring, including in obvious places where radials would be eliminated and replaced with crosstown routes. The study's contact is not sure if there is demand for more east-west crosstown type service in this area.

Finally, RT has inaugurated semi-express, BRT-style service in places like Stockton Boulevard (and other major arterials). The BRT implemented here is low-cost BRT consisting of consolidated stops and signal preemption, and not dedicated right of way. The study's contact believes that corridors like Stockton Boulevard are rich transit corridors, and thus BRT-like initiatives are good ways of providing additional transit capacity and obtaining additional ridership.

Transit and Development

Sacramento has attempted to use transit as a tool to reshape development, both in the center city and at its LRT stations. One of the study's contacts pointed to gentrification in the midtown area, which he believes is having a positive effect on ridership.

The MPO (SACOG) has embraced transit-oriented development (TOD) as a development strategy as part of its Metropolitan Transit Plan and its regional land use planning efforts. The authors' contacts are optimistic about TOD's prospects in the Sacramento area, and one contact singled out student housing near a station at 65th Street, the R street corridor with supermarket and residential development, and Rancho Cordova where there is retail and mixed use around stations as successes. The study's contacts have no knowledge about a systematic evaluation of TOD's effects on transit ridership in Sacramento.

DISCUSSION

The story of transit service planning, and its effectiveness, in Sacramento is one with mixed results. On the positive side, the strong multidestination rail ridership pattern provides evidence that RT has successfully tapped into the decentralized ridership market. This is the source of its patronage strength. If the rail only served CBD-bound trips, rail patronage would be one-third of its present level. Patronage could be higher still if RT's most recent service extensions offered service that was more attractive to non-traditional riders. Such service offerings would require close coordination with bus services. This is exactly the kind of service planning for which RT was once well known.

Unfortunately, the authors see a pattern of back-sliding in the multidestination concept, particularly as it had been applied to an integrated bus and rail network, resulting in a reversal of earlier favorable trends in riding habit and productivity growth. The authors also see recent rail extensions implemented without proper planning and provision toward getting patrons to the nearby suburban destinations of the sort that patrons on the earlier part of the system actually reach, as evidenced by the rail station alighting data discussed earlier. Consequently, these major rail investments have been ineffectual in stimulating ridership commensurate with service expansion. During this same period of time, RT bus service has increased substantially, but clearly (by evidence that there are inadequate bus connections) the increases have not occurred in the corridors where the rail extensions have been made. Where they have been made, the bus service expansions have failed to generate ridership growth. Both the lack of using the rail investment to reach suburban destination by failing to provided adequately integrated suburban bus service, together with the ineffectual deployment of additional bus service in other parts of the system, result in a reversal of very promising riding habit and productivity trends that the system enjoyed during the 1990s.

APPENDIX I
SALT LAKE CITY, UTAH

SETTING

For this study, the authors define the Salt Lake City Metropolitan Statistical Area as including the counties that make up the Ogden, Provo, and Salt Lake City MSAs as defined by the Office of Management and Budget.[210] The Utah Transit Authority (UTA) provides service to counties in all three MSAs.

The Salt Lake City Metropolitan Statistical Area (MSA) consists of eight counties in northern Utah with a land area of just under 16,420 square miles.[211] With just under 2 million persons in 2005, the Salt Lake City MSA ranks as the nation's 28th largest in population.[212] The Salt Lake City MSA's population density is just over 120 persons per square mile.

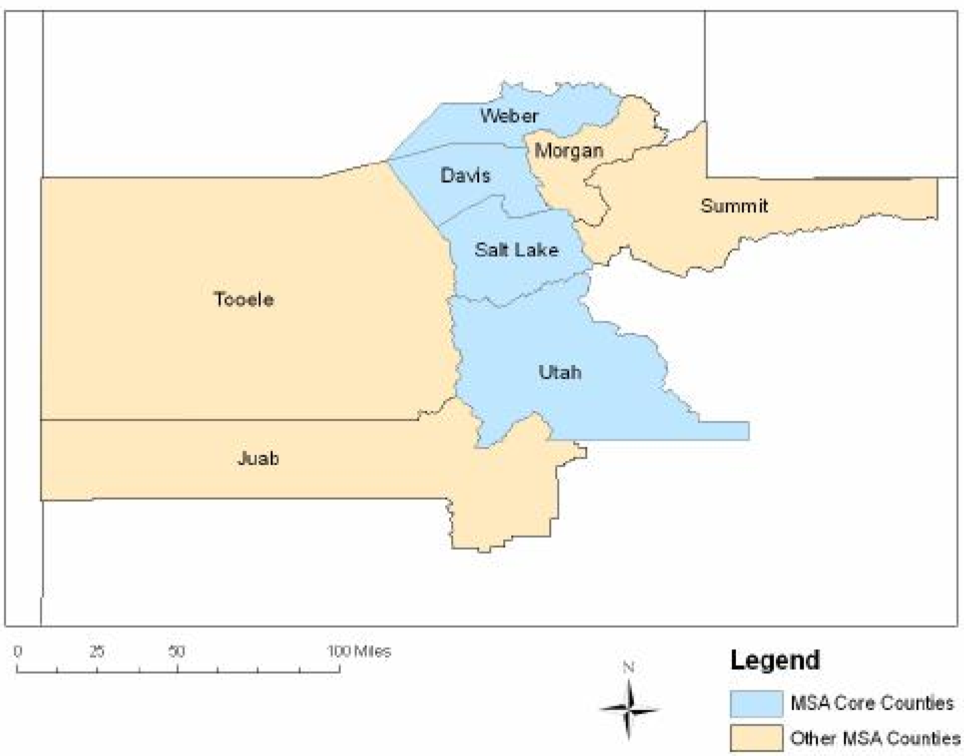


Figure 120 Salt Lake City metropolitan statistical area

The MSA core consists of four counties (Davis, Salt Lake, Utah, and Weber) that are home to the metropolitan area's major cities (Salt Lake City, Ogden, and Provo) (see Figure 120). The four MSA core counties have a combined population of approximately 1.9 million persons and an average population density of 520 persons per square mile. These four counties are served by the Utah Transit Authority, the Salt Lake City metropolitan area's public transit agency. Large portions of the OMB-defined MSA encompass sparsely populated desert or mountain lands.

Distribution of MSA Population

Salt Lake City is a growing metropolitan area. Population has increased and decentralized since 1970, as shown in Figure 121. This figure provides maps of population by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of population from Salt Lake County at the center of the metropolitan area first to Utah and Weber Counties and then to Davis County.

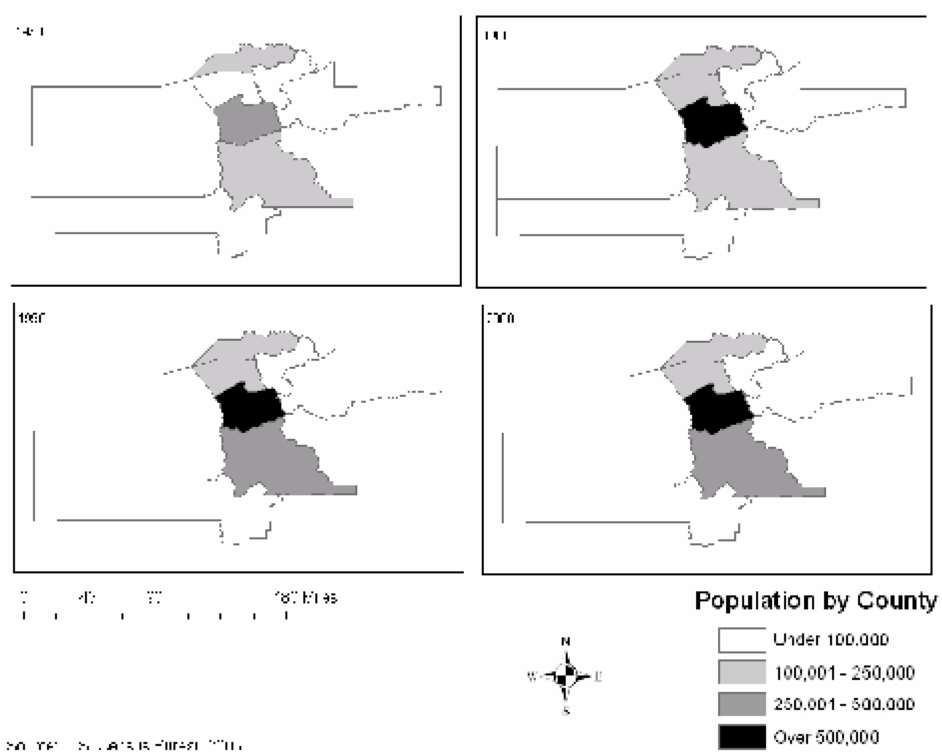


Figure 121 Salt Lake City MSA: population by county (1970-2000)

Between 1970 and 2005, total MSA population increased 130% from 850,000 to just under 2 million persons (see Table 126). Population has grown rapidly in all parts of the region, although population growth in the MSA core counties excluding Salt Lake County (156%) exceeds population growth in Salt Lake County (107%). The four MSA core counties accounted for 95% of MSA population in 1970, and 94% of MSA population in 2005. Population growth in the non-core counties has been rapid (187%), but the total population residing outside the MSA core is barely over 100,000 persons. Large portions of the four non-core counties consist of sparsely populated desert or mountain environments.

Table 126 Population in the Salt Lake City metropolitan area (1970–2005)

Year	Salt Lake County	MSA Core Counties (4 counties)	Other MSA Counties (4 counties)	Total MSA (8 counties)
1970	458,607	821,689	35,981	857,670
1971	476,700	855,600	37,000	892,600
1972	487,800	880,900	37,900	918,800
1973	501,600	906,000	38,300	944,300
1974	513,800	929,600	38,700	968,300
1975	528,000	955,000	40,100	995,100
1976	546,100	984,800	40,700	1,025,500
1977	562,500	1,019,500	41,800	1,061,300
1978	581,000	1,054,800	43,700	1,098,500
1979	600,100	1,093,900	45,300	1,139,200
1980	619,066	1,128,328	46,678	1,175,006
1981	642,270	1,169,966	48,143	1,218,109
1982	657,401	1,198,986	49,492	1,248,478
1983	672,962	1,226,067	50,186	1,276,253
1984	685,570	1,247,165	50,829	1,297,994
1985	693,445	1,263,948	51,624	1,315,572
1986	702,636	1,280,869	51,957	1,332,826
1987	708,855	1,296,455	51,924	1,348,379
1988	714,436	1,307,671	52,195	1,359,866
1989	719,048	1,322,499	52,562	1,375,061
1990	729,893	1,342,487	53,876	1,396,363
1991	751,023	1,380,021	55,932	1,435,953
1992	774,408	1,424,055	57,998	1,482,053
1993	798,049	1,469,903	60,975	1,530,878
1994	819,039	1,513,676	64,350	1,578,026
1995	836,008	1,549,567	67,547	1,617,114
1996	853,076	1,587,801	70,538	1,658,339
1997	871,580	1,625,201	73,889	1,699,090
1998	881,840	1,656,988	78,005	1,734,993
1999	891,116	1,682,356	82,150	1,764,506
2000	898,387	1,707,116	85,917	1,793,033
2001	910,045	1,742,441	90,678	1,833,119
2002	917,557	1,762,185	93,903	1,856,088
2003	924,896	1,785,157	97,177	1,882,334
2004	934,838	1,838,588	100,299	1,938,887
2005	948,172	1,878,593	103,339	1,981,932

Source: U.S. Census Bureau, 2007.

Figure 122 displays population density inside the urbanized portions of Davis, Salt Lake, and Weber Counties for 2006, by transportation analysis zone (TAZ). (The authors were unable to obtain similar data for Utah County.) The figure shows large population clusters in Salt Lake City and its immediately adjacent suburbs. The figure also identifies a corridor extending from Salt Lake City north to Ogden that represents a major population cluster. From the figure it is apparent that population is both decentralized and clustered in the more developed portions of the Salt Lake City MSA.

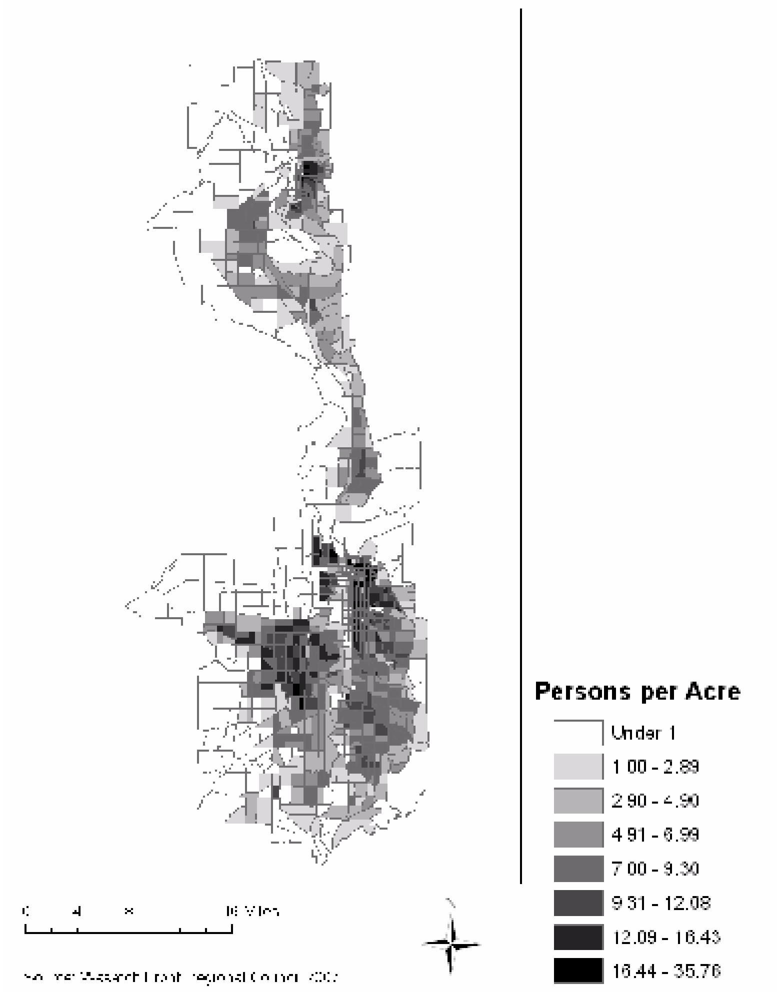


Figure 122 Salt Lake MSA: Population Density by transportation analysis zone (2006)

Distribution of MSA Employment

Employment has grown and decentralized over the past several decades, but it remains much more concentrated than population. Figure 123 provides maps of employment by county in 1970, 1980, 1990, and 2000, using a common classification scheme. The maps show a gradual spreading of employment from Salt Lake County to Utah County and then the other MSA core counties.

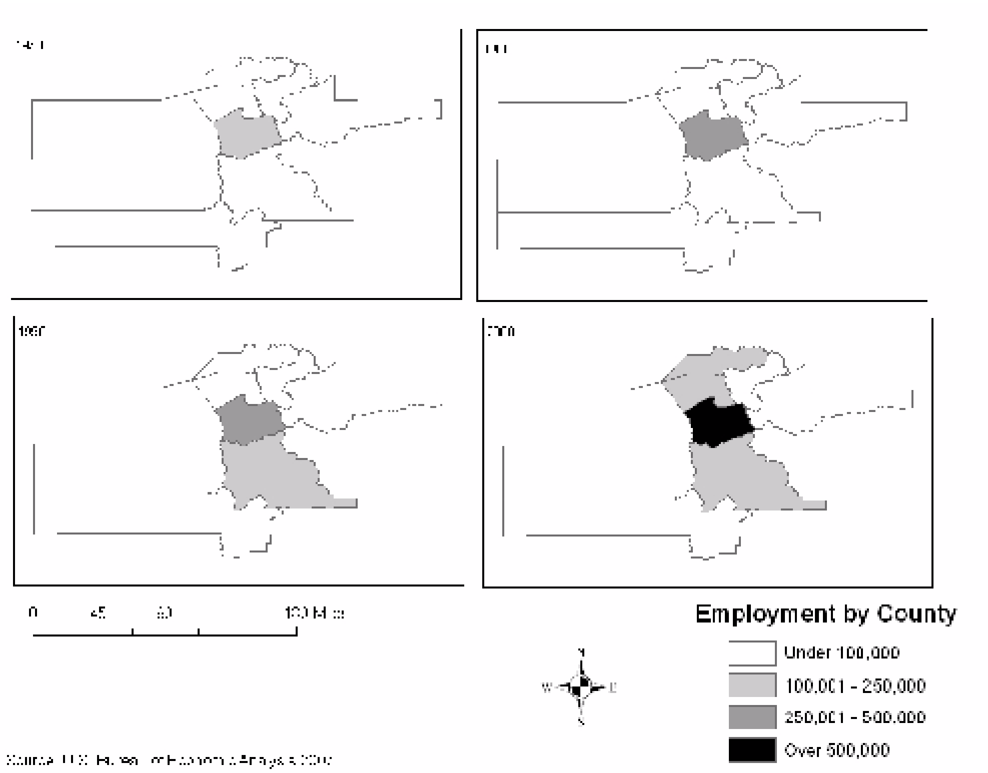


Figure 123 Salt Lake City MSA: employment by county (1970–2000)

Between 1970 and 2005, total MSA employment increased more than 230% from 373,000 to 1.2 million jobs (see Table 127). Employment increased in all parts of the Salt Lake MSA, and by fairly similar percentages. Salt Lake City CBD employment increased 178%, and non-CBD employment in Salt Lake County increased 224%. MSA core counties employment increased 230%, while employment in the non-core counties increased 233%. The net result is that both Salt Lake County and the combined MSA core counties retained their shares of total MSA employment between 1970 and 2005. In 2005, Salt Lake County accounted for 57% of MSA employment, and the four MSA core counties accounted for 95% of MSA employment.

Figure 124 displays employment density inside the urbanized portions of Davis, Salt Lake, and Weber Counties for 2006, by transportation analysis zone (TAZ). (The authors were unable to obtain similar data for Utah County.) The map displays jobs per acre by transportation analysis zone (TAZ), using classification categories based on natural breaks in the data. The figure shows that employment is much more clustered (and less scattered) than population in these core counties. Most employment clusters are located within a few miles of the Salt Lake City CBD, although there are more distant clusters running in a corridor along Interstate 15 to the south and in Ogden to the north.

Table 127 Employment in the Salt Lake City metropolitan area (1970–2005)

Year	Salt Lake County			MSA Core Counties (4 counties)	Other MSA Counties (4 counties)	Total MSA (8 counties)
	CBD	Outside CBD	Total			
1970	18,249	198,796	217,045	356,097	16,986	373,083
1971	19,298	205,473	224,771	367,000	16,953	383,953
1972	20,408	217,688	238,096	388,401	16,971	405,372
1973	21,581	233,108	254,689	412,276	17,349	429,625
1974	22,822	244,392	267,214	430,042	18,367	448,409
1975	24,135	246,676	270,811	434,843	18,624	453,467
1976	25,522	258,907	284,429	456,750	18,717	475,467
1977	26,990	274,273	301,263	482,663	19,853	502,516
1978	28,542	293,932	322,474	515,412	19,844	535,256
1979	30,183	304,710	334,893	536,217	20,885	557,102
1980	31,920	306,957	338,877	541,231	21,936	563,167
1981	33,114	309,035	342,149	547,123	23,389	570,512
1982	34,352	314,192	348,544	555,970	23,016	578,986
1983	35,637	320,576	356,213	567,657	22,896	590,553
1984	36,970	341,040	378,010	603,194	24,569	627,763
1985	38,353	354,640	392,993	628,570	25,158	653,728
1986	39,787	359,389	399,176	641,729	25,397	667,126
1987	41,275	372,909	414,184	665,551	26,222	691,773
1988	42,819	385,721	428,540	694,160	27,289	721,449
1989	44,420	397,440	441,860	719,584	28,781	748,365
1990	46,078	414,728	460,806	753,372	29,541	782,913
1991	46,525	425,169	471,694	771,736	30,026	801,762
1992	46,976	433,205	480,181	784,233	31,182	815,415
1993	47,432	461,444	508,876	822,531	32,124	854,655
1994	47,892	490,207	538,099	878,463	35,025	913,488
1995	48,357	513,651	562,008	917,767	36,637	954,404
1996	48,826	543,778	592,604	971,622	38,929	1,010,551
1997	49,299	565,380	614,679	1,010,815	41,433	1,052,248
1998	49,777	584,782	634,559	1,041,942	42,854	1,084,796
1999	50,260	596,687	646,947	1,066,402	44,038	1,110,440
2000	50,770	615,504	666,274	1,098,327	45,875	1,144,202
2001	50,785	613,081	663,866	1,100,386	47,659	1,148,045
2002	50,800	605,375	656,175	1,096,244	48,806	1,145,050
2003	50,816	603,818	654,634	1,101,701	50,203	1,151,904
2004	50,831	615,011	665,842	1,129,916	52,341	1,182,257
2005	50,846	643,709	694,555	1,175,039	56,592	1,231,631

Sources: U.S. Bureau of Economic Analysis 2007; U.S. Census Bureau 1970, 1980, 1990, 2000.

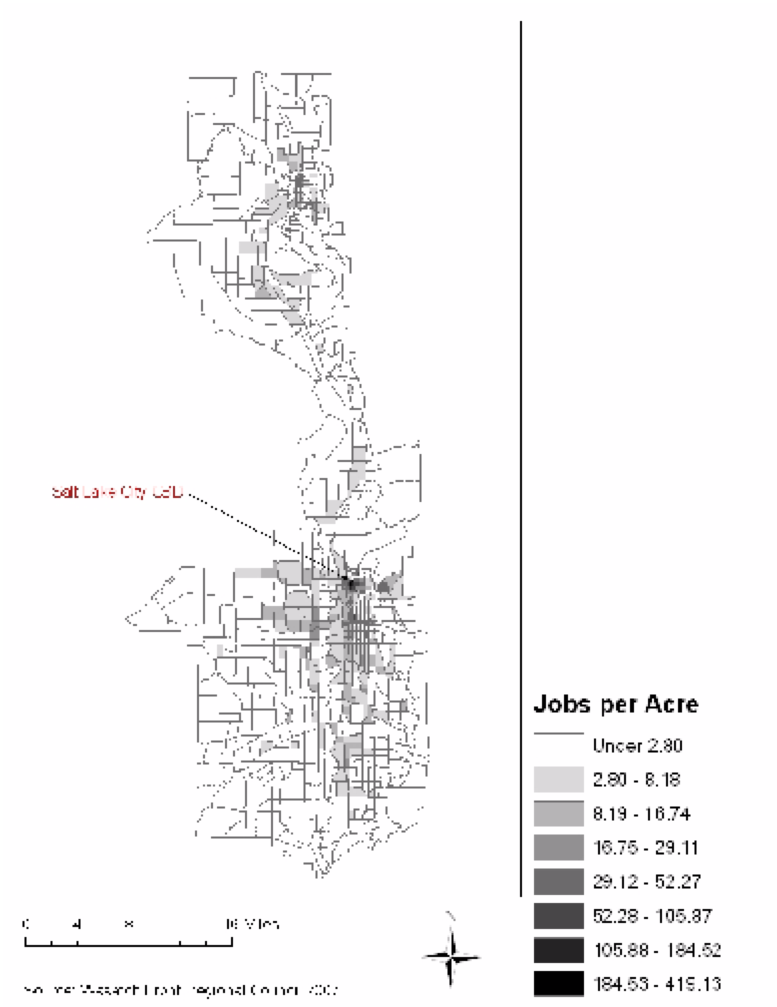


Figure 124 Salt Lake City MSA: employment density by transportation analysis zone (2005)

The Salt Lake City MSA clearly emerges from this brief examination of population and employment growth and distribution as a growing, decentralized metropolitan area. Both population and employment are decentralized, but both are clustered. Employment is less decentralized than population, as shown in Figure 124. This pattern of potential travel destinations has clear implications for the structure of the transit systems in the region. It suggests the use of major trunk routes to serve the identified clusters and corridors shown on the population and, particularly, employment density maps. The authors discuss the transit system in Salt Lake City later in the case study.

Institutions and Key Actors

Three public sector entities have played (and continue to play) important roles in transit policy and planning in the Salt Lake City metropolitan area. These actors are Utah Transit Authority (UTA), Wasatch Front Regional Council (WFRC), and the state of Utah. The Church of Jesus

Christ of Latter Day Saints (LDS) has also played a role, although a less visible one, particularly since the LRT line opened in 2000.

Utah Transit Authority (UTA)

Utah Transit Authority (UTA) is the transit agency in the Salt Lake City metropolitan area. UTA operates bus and light rail transit (LRT) services. UTA's service area includes portions of six counties: Box Elder, Davis, Salt Lake, Tooele, Utah, and Weber. UTA is governed by a 16-member appointed board, with members appointed by cities and counties that provide local sales tax revenue to fund UTA service.

Wasatch Front Regional Council (WFRC)

Wasatch Front Regional Council (WFRC) is the metropolitan planning organization (MPO) for the Salt Lake City metropolitan area. WFRC covers five counties: Davis, Morgan, Salt Lake, Tooele, and Weber. WFRC is governed by an 18-member board appointed to include elected officials from member jurisdictions; an additional three non-voting members represent the Utah Association of Counties, Utah League of Cities and Towns, and Envision Utah, a public-private partnership focused on managing growth in a more sustainable and environmentally friendly manner. As the MPO, WFRC is responsible for approving both the short-term Transportation Improvement Program (TIP) and Long Range Transportation Plan (LRTP) required for federal aid projects.

State of Utah

The state Legislature and Governor of Utah have played roles in transit development, particularly during the years preceding the opening of the LRT.

Church of Jesus Christ of Latter Day Saints (LDS)

The Church of Jesus Christ of Latter Day Saints (LDS) has generally been supportive of rail transit development in the Salt Lake City area, but has generally taken a background role. One of the interviewees noted that Church support has increased since the LRT opened in 2000.

Transit Agency, Modes, Fares, and Rider Profiles

The Utah Transit Authority is the single public transit agency in the Salt Lake City metropolitan area. UTA operates fixed-route bus (108 routes), light rail transit (LRT) (3 lines), and paratransit services in the Salt Lake City area (see Figure 125). UTA is developing commuter rail service to connect Salt Lake City to both Ogden and Provo.

The one-way adult local bus base fare is $1.60, and the one-way adult premium express bus fare is $3.25.[213] UTA provides discounted fares for students, senior citizens, the disabled, and persons on Medicare. UTA sells day and monthly passes, as well as multi-ride tickets. Local bus fares allow riders to transfer between local bus and LRT, called TRAX, while premium express bus fares allow riders to transfer between express bus and LRT. UTA's LRT system, TRAX, opened in 1999 (see Table 128).

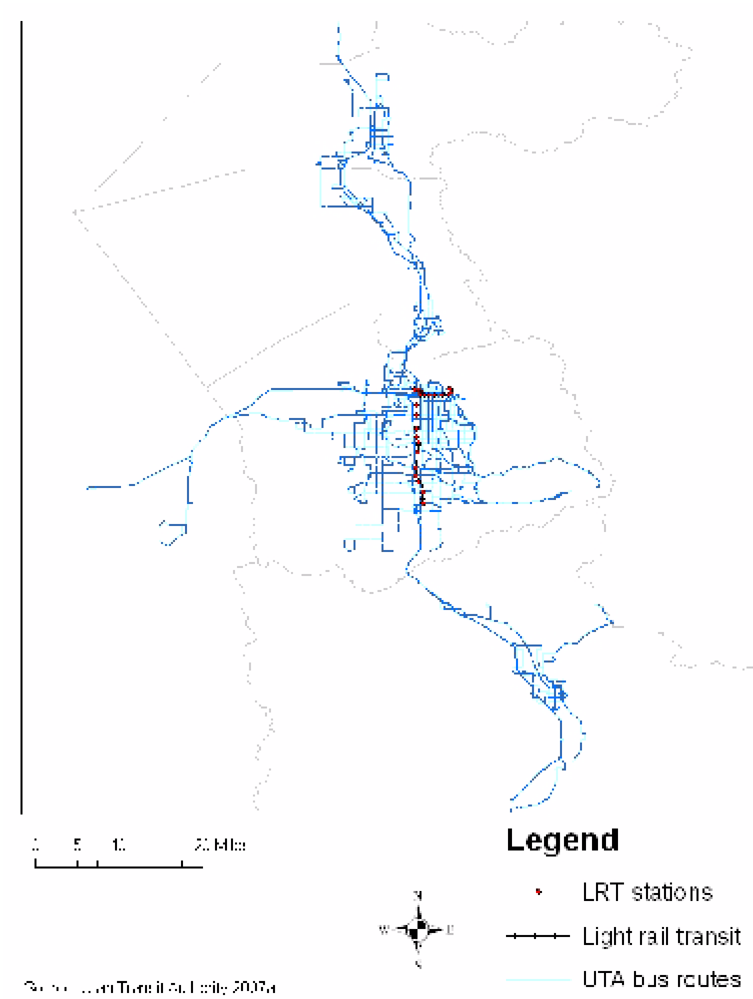


Figure 125 Transit system in the Salt Lake City metropolitan area (2007)

UTA Ridership Profile

The study's interviewee provided a characterization of UTA riders.[214] (The authors were unable to obtain survey data from UTA.) He observed that most bus users are transit dependent riders. Before LRT began service, bus ridership was more peaked than it is presently. LRT riders include more choice riders. Among current rail riders, about 50% access the LRT by automobile and about one third by bus. In morning peak period, light rail trains carry a "decent" passenger load out of the Salt Lake City CBD. Whereas north-bound trains have standees, south bound trains have fully seated loads. In the middle of the day, trains are half full in both travel directions.

The authors' contact observed that riders who use park and ride lots are a lot different than those who access the system other ways, regardless of whether the lots serve trains or buses.

These riders reflect characteristics of general population. Most park and ride users are traveling to downtown or to the university, where parking is scarce. These users are choice riders.

Table 128 Salt Lake City light rail transit segment openings

Year	Segment Length (miles)	Line	Section	Cumulative System Length (miles)
1999	15.0	North/South TRAX Line	Delta Center–10000 South	15.0
2001	2.5	University TRAX Line	Main St. & 400 South–Stadium	17.5
2003	1.5	University TRAX Line	Stadium–University Medical Center	19.0

Source: Leroy Demery, *U.S. Urban Rail Transit Lines Opened from 1980*, October 18, 2005, p.25.

ANALYSIS

Regional Transit Vision

The study's interviewee provided an overview of the history of transit development in the Salt Lake City area.[215] He stated that the structure of the region dictated its long range transportation vision. Salt Lake City is located on a long, linear plain bounded by mountains on the east and either the lake or mountains on the west. This structure suggested a north-south orientation for major transportation investments, to which east-west appendages were then attached. The interviewee observed that the physical characteristics of the region allow the largely radial bus system to easily function as a grid system as well, because north-south bus routes run for miles on parallel arterials before dipping into the CBD. This interviewee observed that the first expression of the regional transit vision may have been the Salt Lake County Master Plan of 1979, which never was adopted because of jurisdictional jealousies. The main focus was on bus system expansion due to the recent (1973) appearance of ¼ cent sales tax money.

In the 1980s, the emphasis shifted to planning a combined LRT line and freeway redevelopment in the north-south corridor. The study's interviewee observed that highway supporters probably were strong enough to stop rail had they wanted to do so; the rail supporters were not strong enough to stop the freeway project. The authors' contact reflects that a combined LRT-freeway approach was deemed the strongest politically. The business community solidly supported the highway initiatives and offered weaker support to the light rail initiative. If asked to choose, business leaders undoubtedly would have supported more road construction, but there was some strong support for LRT, particularly from downtown business groups who saw problems with a freeway approach for providing downtown access. Today, there is a sense that both freeways and LRT are required, and UTA and the state DOT make public statements that are supportive of the other mode of transportation.

The interviewee observed that rail support began growing slowly in the early 1980s thanks to the support of the governor of the time and the opening of LRT in San Diego, which became a role model for Salt Lake City. After a change of governors, state support dissipated, although local support remained. LRT fell to the wayside until an unsuccessful attempt was made to enact a sales tax in 1992. Suburban interests led the opposition to this effort; this contact believes that the opposition was due to the nature of the LRT plan they had been presented.

The 1992 proposal included only a north-south line, and left many communities unserved. UTA subsequently repackaged LRT as serving a broader geographic area. This repackaging, combined with federal support (in the form of an 80% federal contribution to construction cost) to assist Salt Lake City's preparation for the Olympics are seen as crucial in LRT's emergence and implementation.

Regional Transit System Structure and Function

The authors' contact described the roles that the various modes play in serving passengers in Salt Lake City.[216] He states that LRT and freeways are planned largely to serve the same travel needs, particularly in the north-south corridor. Prior to LRT implementation, there was debate between implementing a bus/HOV system or an LRT system. The contact notes that bus/HOV was less appealing, because LRT could serve intermediate destinations, such as smaller city commercial centers that originally built up around the railroad lines of the nineteenth century.

The major bus routes are on the north-south arterials; they fold into the Salt Lake City CBD. The study's contact says the system functions well and is easy to operate with a handful of strong north-south routes. When LRT opened, east-west bus service was in place on some arterials close to the CBD. In the far south of the service area there were some express buses that ran to the CBD. Some of these routes were converted to east-west LRT feeders. The interviewee feels that the current level of east-west bus service is sufficient. UTA recently implemented major service changes that included improving frequency to 15 minutes on some inner area routes and discontinuing some service in low density areas. The changes have been controversial.

UTA is developing commuter rail that is scheduled to open in April 2008 with service to Ogden, 35 miles north of Salt Lake City. The line will cater to work trips, but it will offer good service (30 minute peak and 60 minute off peak service) all day long. UTA anticipates attracting some reverse commuting (20% of peak direction travel) and some midday ridership, similar to their ridership on LRT.

Transfers

The study's contact reports that the transfer rate is about one-third of transit riders.[217] The contact calculated the transfer rate as the number of boardings divided by linked trips; the result for UTA is 1.35. The contact notes that the transfer rate went up a little with the introduction of LRT, largely because of the need for university-bound users to transfer from one rail line to another to make their trip.

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

The Salt Lake City metropolitan area has experienced dramatic fluctuations in both riding habit (measured as passenger miles per capita) and service productivity (measured as passenger miles per vehicle mile, or load factor) between 1984 and 2004. Figure 126 plots riding habit between 1984 and 2004. Noted on the graph are important service changes the authors identified in the course of this research.

The figure shows that riding habit increased from 1984 to 2004, but that there was sizeable variation in the intervening years. A quick examination of service provision (shown in Table 131 later in the study) shows that the peaks and valleys do not correspond to dramatic changes in the amount of service supplied. It is possible that fare changes (for which the authors lack data) are partially responsible for these fluctuations.

Figure 127 shows service productivity over the same period. Service productivity declined slightly from 1984 to 2004, but again there were wide fluctuations in the intervening period. Recent improvements in service productivity appear to correspond to extensions of the LRT line or major events like the 2002 Winter Olympics.

UTA System Ridership and Productivity Trends

Table 129 provides an examination of ridership (measured on both a passenger miles basis and an unlinked passenger trip basis) by mode for UTA. The table shows that bus ridership increased from the mid-1980s through the mid-to-late 1990s before declining in recent years. However, both the increases and declines have been marked by fluctuations during intervening periods. The decline in bus passenger miles (22%) was larger than the decline in unlinked passenger trips (7%), which indicates a reduction in the average bus trip length. This is indeed the case, as Table 130 indicates.

The declines in bus ridership from 2001 tom 2002 and from 2003 to 2004 are particularly striking. These are the periods when important segments of LRT opened. Normally, one would expect unlinked bus trips to stay the same after the introduction of rail, as those bus riders who transfer to rail are making a new unlinked trip on rail but not subtracting an unlinked trip from bus. Here, the reader see marked declines in bus unlinked trips, suggesting that a substantial number of bus passengers completely switched from bus to light rail.

LRT ridership, on the other hand, has increased steadily since the first LRT segment opened in 1999 (see Table 129). The average LRT trip length has decreased over the several years the LRT service has been in place, which suggests greater use of LRT for trips other than long distance trips to and from the CBD. This study's interview suggests that people are indeed using LRT for an increasingly diverse array of trip purposes and to reach a variety of travel destinations.

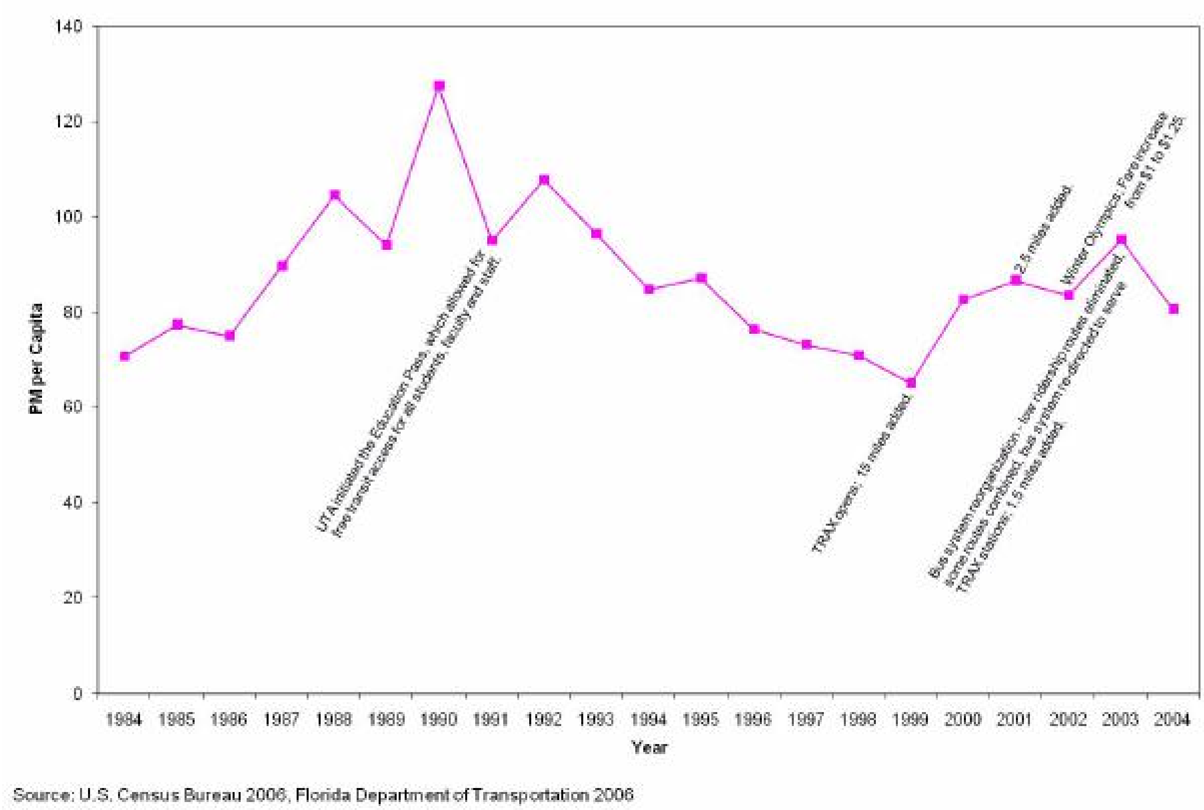


Figure 126 Salt Lake City MSA riding habit (passenger miles per capita) (1984-2004)

Table 131 reports information about transit service supplied for UTA bus and UTA LRT services between 1984 and 2004. The table shows that bus service increased steadily from the mid-1980s until the mid-1990s, before declining and then increasing in recent years. The result is a 54% increase in bus service over this period. Rail service has increased since the opening of the first LRT segment in 1999 and in tandem with subsequent system expansions.

UTA increased bus service at a time when bus ridership declined. The result is a large decline in bus service productivity (measured as passenger miles per vehicle mile, or load factor). Table 132 shows that bus service productivity declined by nearly half from 1984 to 2004, although service productivity fluctuated a great deal in the intervening years. Bus productivity in Salt Lake City is now very low, ranking lowest among the eleven study cities. Rail service productivity has declined since the time the system opened, although this is to be expected as the short starter segment was extended to reach destinations beyond the core of the system. Overall UTA system-wide service productivity has declined slightly between 1984 and 2004.

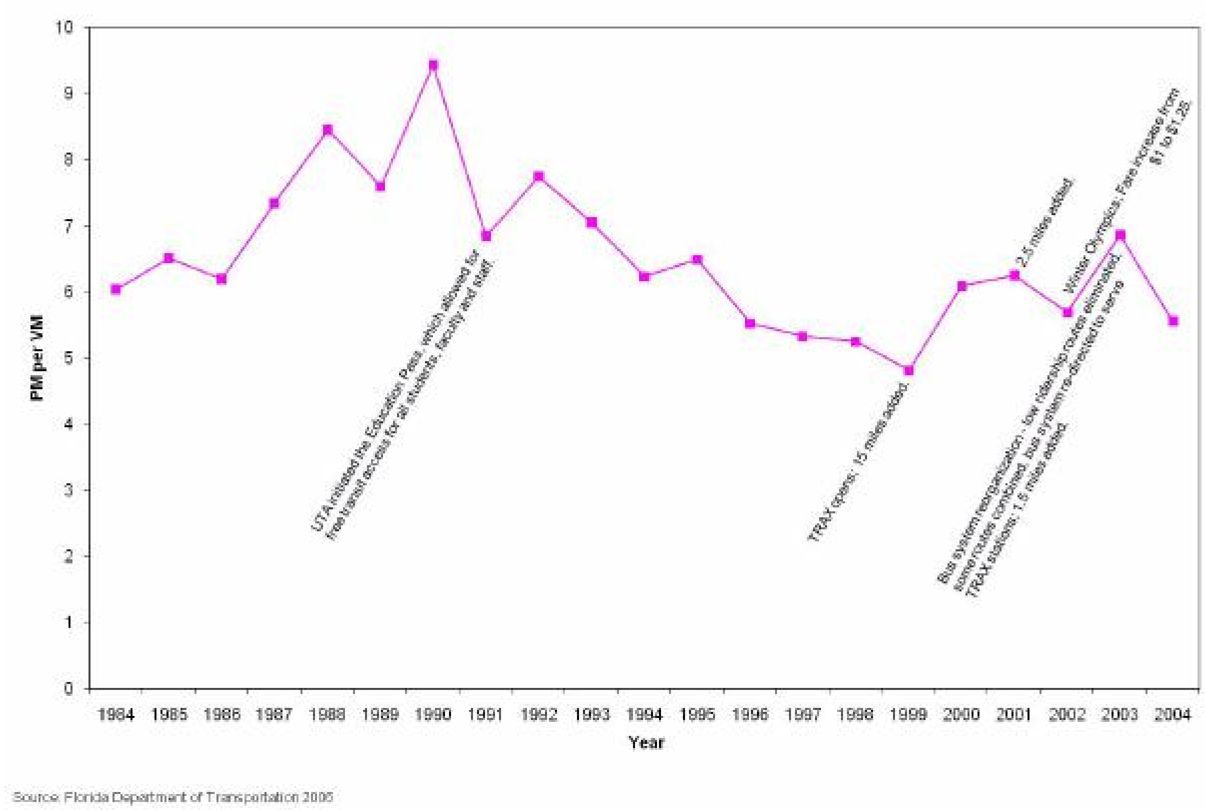


Figure 127 Salt Lake City MSA load factor (passenger miles per vehicle mile) (1984–2004)

Table 129 Ridership on UTA fixed-route transit services (1984–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	UTA Bus	UTA Rail	UTA Total	UTA Bus	UTA Rail	UTA Total
1984	77,453,495		77,453,495	16,358,773		16,358,773
1985	85,931,623		85,931,623	16,974,972		16,974,972
1986	84,460,419		84,460,419	17,022,629		17,022,629
1987	102,088,933		102,088,933	19,990,281		19,990,281
1988	119,918,060		119,918,060	20,923,230		20,923,230
1989	108,744,832		108,744,832	20,990,360		20,990,360
1990	149,446,550		149,446,550	23,701,902		23,701,902
1991	114,437,896		114,437,896	24,300,275		24,300,275
1992	133,625,387		133,625,387	27,038,915		27,038,915
1993	123,336,736		123,336,736	24,806,901		24,806,901
1994	111,499,335		111,499,335	16,358,773		24,343,063
1995	117,095,566		117,095,566	24,343,063		24,492,416
1996	104,969,002		104,969,002	24,492,416		23,838,374
1997	102,907,424		102,907,424	24,294,763		24,294,763
1998	101,322,034		101,322,034	24,044,494		24,044,494
1999	88,597,276	6,023,658	94,620,934	22,342,518	614,659	22,957,177

Table 129 Ridership on UTA fixed-route transit services (1984–2004)

Year	Passenger Miles			Unlinked Passenger Trips		
	UTA Bus	UTA Rail	UTA Total	UTA Bus	UTA Rail	UTA Total
2000	72,436,918	49,672,144	122,109,062	17,745,156	6,132,356	23,877,512
2001	85,251,359	44,555,857	129,807,216	19,018,591	6,084,314	25,102,905
2002	73,014,665	53,746,722	126,761,387	17,547,836	9,755,050	27,302,886
2003	91,173,389	55,205,513	146,378,902	20,665,353	9,814,098	30,479,451
2004	60,113,406	65,708,804	125,822,210	15,265,982	10,019,863	25,285,845

Source: Florida Department of Transportation 2006.

Table 130 Average trip lengths (UTA) (1984–2004)

Year	Average Trip Length (miles)		
	UTA Bus	UTA Rail	UTA Total
1984	4.73		4.73
1985	5.06		5.06
1986	4.96		4.96
1987	5.11		5.11
1988	5.73		5.73
1989	5.18		5.18
1990	6.31		6.31
1991	4.71		4.71
1992	4.94		4.94
1993	4.97		4.97
1994	4.58		4.58
1995	4.78		4.78
1996	4.40		4.40
1997	4.24		4.24
1998	4.21		4.21
1999	3.97	9.80	4.12
2000	4.08	8.10	5.11
2001	4.48	7.32	5.17
2002	4.16	5.51	4.64
2003	4.41	5.63	4.80
2004	3.94	6.56	4.98

Source: Florida Department of Transportation 2006.

Table 131 UTA fixed-route transit service (1984–2004)

Year	Vehicle Miles		
	UTA Bus	UTA Rail	UTA Total
1984	12,808,515		12,808,515
1985	13,197,128		13,197,128
1986	13,622,130		13,622,130
1987	13,900,672		13,900,672
1988	14,191,706		14,191,706
1989	14,323,474		14,323,474
1990	15,842,716		15,842,716
1991	16,720,677		16,720,677
1992	17,256,867		17,256,867
1993	17,495,351		17,495,351
1994	17,884,518		17,884,518
1995	18,037,977		18,037,977
1996	19,013,055		19,013,055
1997	19,326,955		19,326,955
1998	19,293,884		19,293,884
1999	19,541,555	116,823	19,658,378
2000	18,531,746	1,508,956	20,040,702
2001	19,049,484	1,711,504	20,760,988
2002	19,954,467	2,322,850	22,277,317
2003	19,033,719	2,294,449	21,328,168
2004	19,660,840	2,982,557	22,643,397

Source: Florida Department of Transportation 2006.

Table 132 UTA service productivity (1984–2004)

Year	UTA Bus	UTA Rail	UTA Total
1984	6.05		6.05
1985	6.51		6.51
1986	6.20		6.20
1987	7.34		7.34
1988	8.45		8.45
1989	7.59		7.59
1990	9.43		9.43
1991	6.84		6.84
1992	7.74		7.74
1993	7.05		7.05
1994	6.23		6.23
1995	6.49		6.49
1996	5.52		5.52
1997	5.32		5.32
1998	5.25		5.25

Table 132 UTA service productivity (1984–2004)

Year	UTA Bus	UTA Rail	UTA Total
1999	4.53	51.56	4.81
2000	3.91	32.92	6.09
2001	4.48	26.03	6.25
2002	3.66	23.14	5.69
2003	4.79	24.06	6.86
2004	3.06	22.03	5.56

Source: Florida Department of Transportation 2006.

Bus Route Performance Analysis

The authors undertook a more detailed examination of the performance of individual bus routes to understand which types of routes have strong performance and which ones do not. They obtained route-based weekday ridership (passenger trips or boardings) and service (revenue miles) data from UTA's September 2007 report. Using these data, the authors constructed a measure of route performance, passenger trips per revenue mile. They differentiated among the bus routes on the basis of whether they served the Salt Lake City CBD or not. Of a total 108 bus routes, 46 routes serve the Salt Lake City CBD. These 46 routes represent 47% of UTA service and carry 46% of UTA riders.

Table 133 presents the results of the bus route performance analysis. The table reports total ridership and patronage for CBD-serving, non-CBD-serving, and all routes, and reports the performance of the median route in each group on this performance measure (passenger trips per revenue mile). The table shows there is essentially no difference in the performance of CBD-serving and non-CBD-serving bus routes.

Table 133 UTA bus route average weekday performance

Route Type	Bus Routes	Passenger Trips	Revenue Miles	Passenger Trips per Revenue Mile (median)
All Non-CBD routes	62	41,775	29,781	1.10
All CBD routes	46	36,036	26,626	1.09
All routes	108	77,811	56,407	1.09

Calculated from UTA 2007c

Emerging and Declining Ridership Markets

The study's interviewee reported that UTA is attempting to reach a number of emerging ridership markets.[218] This contact noted that an important market UTA is attempting to reach is suburban employment. Currently, some passengers use LRT to reach suburban employment that is located some distance (four to five miles) from rail service. There is not much bus service they can use for this purpose, but some users have organized van pools, utilizing vanpool coordination services offered by UTA. This interviewee sees the potential for employer-based vanpools to emerge when the commuter rail line to Ogden opens. He noted that several large employers are located a few miles north of Ogden.

Currently there are express buses running from Ogden to Salt Lake City carrying 4,000-5,000 riders per day. The entire bus system in the north area is operated by a separate bus unit, and this contact does not know what its manager is going to do about bus service when rail service opens. The study's contact recommends running 1/3 of the buses as feeders to rail stations, running 1/3 of buses to other suburban locations, and discontinuing 1/3 of the bus service. The study's contact observes that the rail will be superior to express buses, because they stop at intermediate points and offer reverse commuter service which, based on UTA's experience in the south, likely will be patronized. In contrast, this contact notes that few riders use the reverse commuter service that the express buses provide, although there is some usage of reverse commute buses in the Provo/Orem area.

UTA plans to use future LRT lines to access non-traditional ridership markets, like reverse commute services and services to suburban employment centers. This study's contact noted that the planned South West LRT line will access suburban employment centers, and that there will be a new community college at the end of this line. The authors' contact emphasized that for the LRT to work, there is a need to be able to walk from stations to employment. There is also planned transit-oriented development (TOD) on this line, as noted below.

Transit and Development

The study's interviewee noted that there is interest in transit-oriented development (TOD) in the Salt Lake City area, but that no such development exists at the present time. This contact noted that Kendall is interested in modest residential developments that seem to be occurring near rail stations that are being built at higher densities than developments nearby. He also noted that a large hospital is being built within walking distance of a station.

Along the line of the planned Southwest LRT, there is a large new urbanist development (currently called Daybreak) of some 5000 acres that will surround the last couple miles of the line. The development will include two LRT stations within the development, located a mile apart, and one station located on the development's edge, another mile away. The developer is providing right of way for the light rail line and the stations. At full build out (in six to seven years time) the development is expected to contain 20,000 to 30,000 residents and 3,000 to 4,000 jobs. Stations will be designed to TOD principles. There will be a terminal park and ride lot, as well.

DISCUSSION

Most striking about Salt Lake City is that the LRT line is doing very well by itself, but it has failed to materially improve overall transit performance. Productivity of the transit system during the five years since LRT's introduction is only marginally better than productivity over the five years prior to its introduction, and while passenger miles have increased somewhat, linked trips have not. This pattern is quite different from that of several other urban regions, where the opening of rail service improved overall transit performance. The authors offer an explanation for this difference in performance.

Salt Lake City is an example of a city that implemented its rail investment differently from cities such as Atlanta, Dallas, and San Diego. Those cities used rail transit as a tool to improve overall transit service productivity, which required large scale alternations to the bus networks when rail transit was implemented. The downtown portions of bus routes in those cities were discontinued when rail transit was implemented. Instead, bus passengers going downtown were required to transfer to trains to complete their trips. As has been seen in those cities, the changes to the bus system actually did result in improved transit productivity. In contrast, in Salt Lake City LRT is used as an enhancement to a bus system that largely remained unchanged from its pre-rail configuration. As a consequence, transit patrons in Salt Lake City have more choice in transit modes than do patrons in Atlanta, for example, because they can continue riding bus service to reach their destination or they can switch to LRT. Passengers are not forced to make a transfer, and they choose the mode that is best for their particular trip. The result has been that many former bus passengers in Salt Lake City have stopped using the bus altogether, as evidenced by a major fall in unlinked bus passenger trips upon the opening of the rail line. Because the same amount of bus service still runs with fewer passengers, bus productivity has fallen.

Another reason that the opening of rail in Atlanta and San Diego improved bus productivity in those regions was that new transit passengers began using the systems in those regions, because the restructured bus services took them to additional places not previously reachable. A new category of transit passenger in those regions was one who used a train and then transferred in the suburbs to catch a bus to their final destination. The absence of bus route restructuring in Salt Lake City means that the system serves no new destinations. Thus, there are no new bus passengers to replace those who have stopped using the bus to take the train instead. One can observe this in Salt Lake City by noting that the start of rail service has resulted in only about a 20% increase in passenger miles and no increase in linked trips, in contrast to major system-wide ridership increases enjoyed by Atlanta or San Diego.

The information that the authors obtained from Salt Lake City does not provide sufficient detail to illustrate where bus patrons have gone to rail instead, but there are possibilities of this happening in the route structure. For example, they suspect that freeway express buses that serve the same origins and same destinations as the LRT have lost passengers to LRT, even as bus services have been retained after LRT's introduction. Another example is the area around the University, where there is a finely spaced network of north-south routes running infrequently. Most of these routes bunch together onto one road through the university, before all traveling on the same road to the CBD. There is a large duplication of service among these routes in the university area and from there to downtown Salt Lake City. Many riders on these routes may have shifted to LRT after the university line opened; yet, bus service remained in place without modification-at least until the very recent service restructuring. LRT may also be attracting a new clientele riding longer distances.

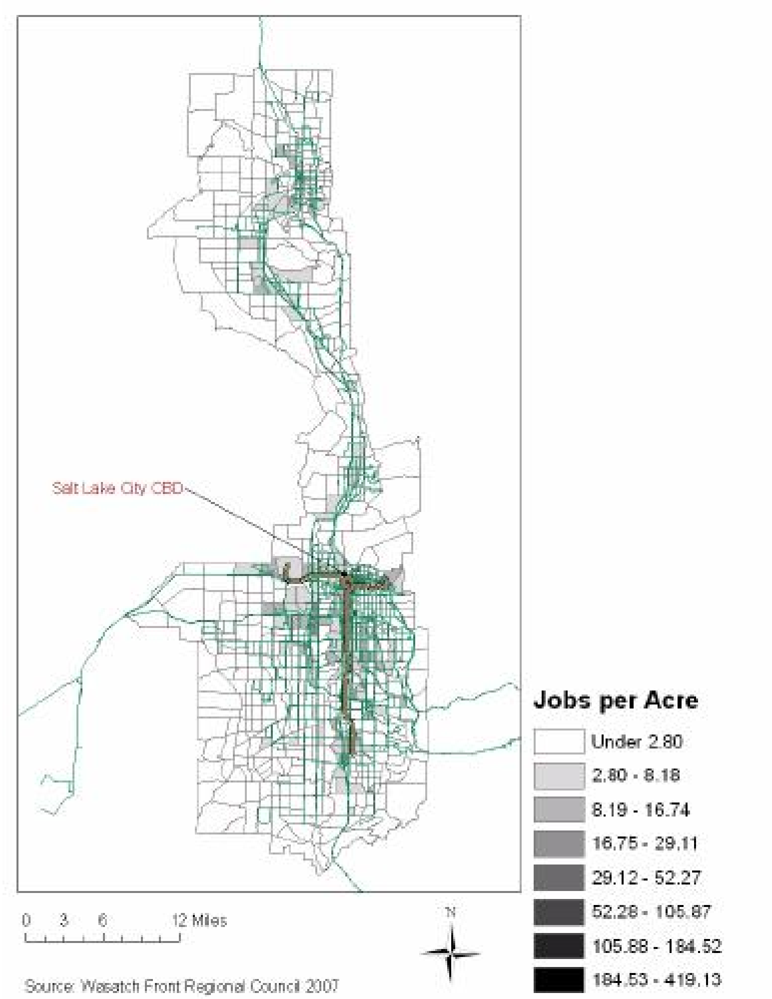


Figure 128 Salt Lake City transit system and its relation to employment (2005)

The experiences of other study areas suggest that Salt Lake City potentially could have higher riding habit and higher productivity on its bus services. What should planners and policymakers do to achieve improvements? Salt Lake City may want to follow the strategy embraced in Portland, Oregon and de-emphasize the arterial radial bus routes serving the CBD, unless they serve lots of employment in their respective corridors and improve service on the east-west arterials that serve lots of employment (see Figure 128). This would allow people using bus to reach more destinations more easily than at the present, and would undoubtedly increase overall ridership and productivity. It would require better coordination of rail and bus that would allow rail to play a role as a distributor of riders to various connecting bus routes, such as occurs in Atlanta with MARTA.

The authors' sense is that Salt Lake City did not leverage its light rail investment to take advantage of its full system-wide ridership and productivity effects, and that although rail is doing quite well on a stand-alone basis it could contribute much more to the entire transit system's ridership and productivity. Recently, UTA undertook a major service restructuring. It is as yet unknown whether this restructuring has achieved the hoped-for ridership and service productivity improvements, or whether both bus and LRT are now being better utilized in the roles for which they are best suited.

APPENDIX J
SAN DIEGO, CALIFORNIA

SETTING

The San Diego Metropolitan Statistical Area (MSA) consists of one county in southern California with a total land area of just under 4,200 square miles (see Figure 129).[219] With just under 3 million persons in 2005, the San Diego MSA ranks as the nation's 17th largest in population.[220] The San Diego MSA's population density is just under 700 persons per square mile, a fairly high density considering the largely uninhabited mountainous terrain that characterizes the eastern half of the county.

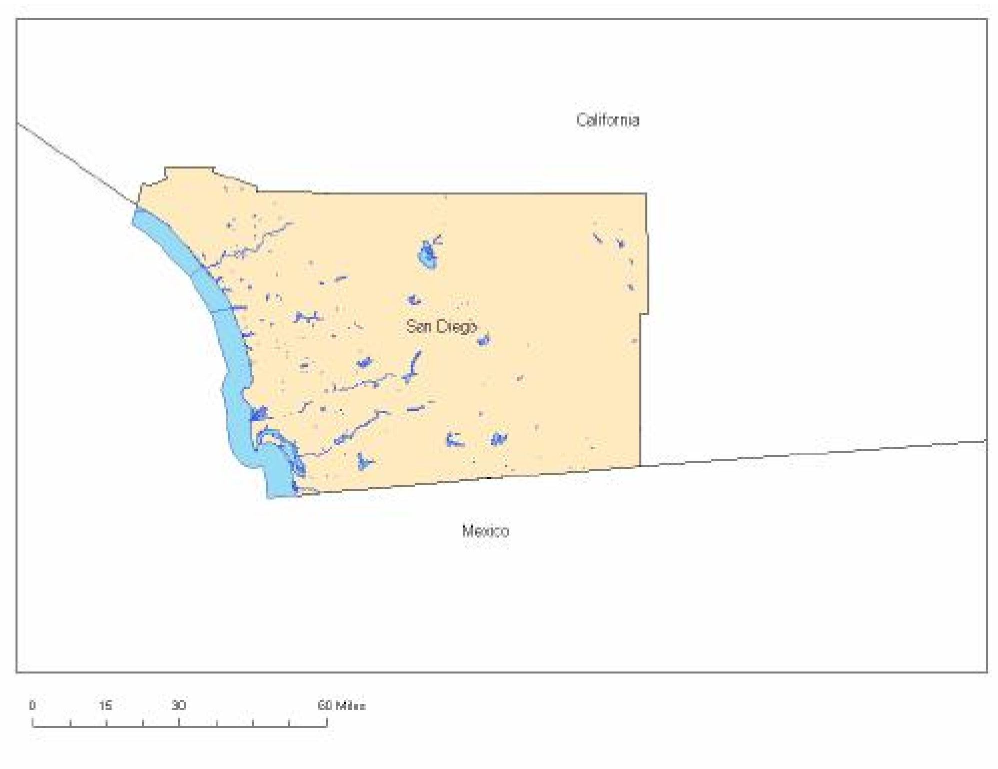


Figure 129 San Diego metropolitan statistical area

San Diego is a growing metropolitan area (see Table 134). Population and employment have increased steadily and decentralized since 1970. Population has more than doubled since 1970. Total MSA employment has increased nearly 200% since 1970. Interestingly, the rate of employment growth in the San Diego CBD (235%) exceeds the rate of employment growth outside the San Diego CBD (189%), although the San Diego CBD is still of quite modest size.

Table 134 Population and employment in the San Diego metropolitan area (1970–2005)

Year	San Diego County Population	San Diego County Employment		
		San Diego CBD	Outside CBD	Total
1970	1,357,854	20,911	626,989	647,900
1971	1,391,900	21,605	627,861	649,466
1972	1,433,100	22,323	649,962	672,285
1973	1,499,600	23,064	684,709	707,773
1974	1,540,700	23,829	714,194	738,023
1975	1,616,900	24,620	731,078	755,698
1976	1,642,800	25,438	761,461	786,899
1977	1,715,500	26,282	811,490	837,772
1978	1,775,400	27,155	873,521	900,676
1979	1,827,600	28,057	923,742	951,799
1980	1,861,846	29,000	960,645	989,645
1981	1,927,018	30,508	966,750	997,258
1982	1,972,354	32,094	972,617	1,004,711
1983	2,018,133	33,763	1,005,481	1,039,244
1984	2,066,419	35,519	1,068,355	1,103,874
1985	2,126,090	37,366	1,129,429	1,166,795
1986	2,196,834	39,309	1,182,274	1,221,583
1987	2,275,309	41,353	1,243,642	1,284,995
1988	2,364,284	43,503	1,315,517	1,359,020
1989	2,444,380	45,766	1,360,985	1,406,751
1990	2,512,365	48,166	1,389,190	1,437,356
1991	2,553,122	49,385	1,397,517	1,446,902
1992	2,593,126	50,634	1,368,005	1,418,639
1993	2,599,776	51,915	1,363,718	1,415,633
1994	2,614,685	53,229	1,368,165	1,421,394
1995	2,623,697	54,575	1,396,762	1,451,337
1996	2,651,549	55,956	1,435,475	1,491,431
1997	2,692,600	57,372	1,477,016	1,534,388
1998	2,736,720	58,823	1,557,526	1,616,349
1999	2,789,593	60,311	1,611,596	1,671,907
2000	2,813,833	61,830	1,671,694	1,733,524
2001	2,862,808	63,394	1,687,342	1,750,736
2002	2,899,193	64,998	1,711,722	1,776,720
2003	2,921,104	66,643	1,742,800	1,809,443
2004	2,935,190	68,329	1,770,588	1,838,917
2005	2,933,462	70,057	1,812,527	1,882,584

Sources: U.S. Census Bureau 2007; U.S. Bureau of Economic Analysis 2007; U.S. Census Bureau 1970, 1980, 1990, 2000.

The authors examined the distribution of population and employment in more detail using data obtained from the San Diego Association of Governments (SANDAG), the San Diego area's metropolitan planning organization (MPO). Figure 130 displays population density in the San Diego MSA for 2006, by census tract. Population density is measured as persons per acre. The map shows that population is decentralized in the western part of San Diego County. Within the western portion of the county, population is clustered, as opposed to evenly dispersed, largely due to the topography. The San Diego area consists of numerous hills, plateaus, and valleys. Large swaths of land are also occupied by major military installations, and thus not open to development. These include the Marine Corp Base Camp Pendleton marine base in the northwest, and the Marina Corp Air Station Miramar (formerly Mirimar Naval Air Station) in the western central part of the county. Population clusters are found in the Oceanside area and the valley between Oceanside and Escondido, in the central coast, in the Interstate 15 corridor, and in the county core centered on San Diego Bay. The eastern portion of the county consists of sparsely populated mountain and desert environments.

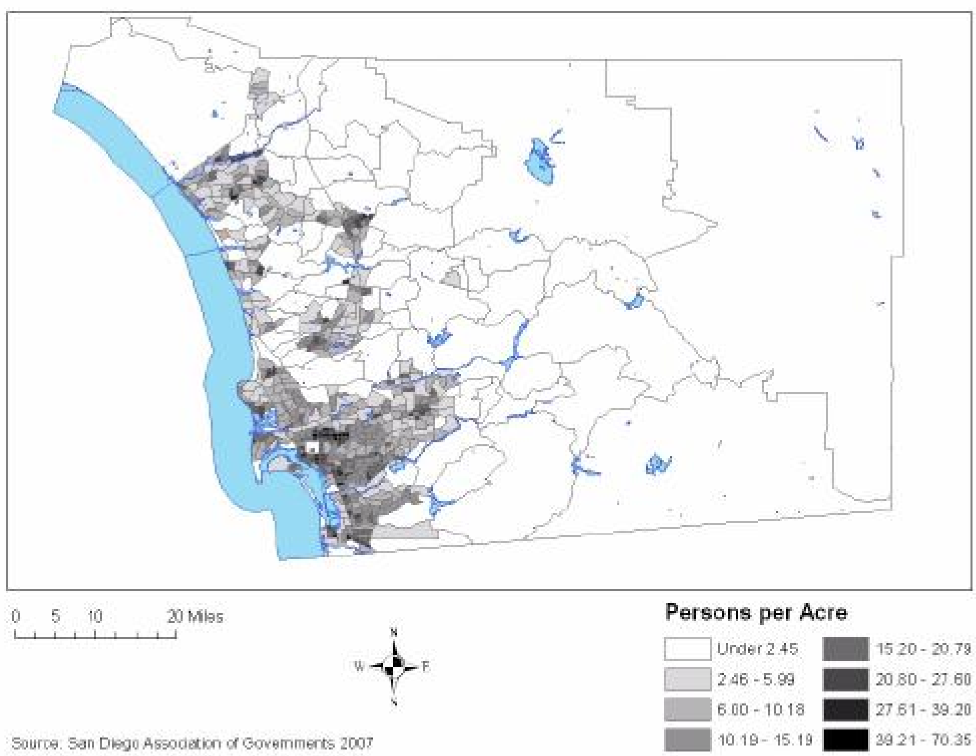


Figure 130 San Diego MSA: population density by census tract (2006)

Figure 131 displays employment density in the San Diego MSA by census tract for 2000, the most recent year for which such data are available. Employment is displayed as the number of jobs per acre. The distribution of employment is shaped by the same topographic and land ownership issues that affect the distribution of population discussed above. Major employment concentrations include the San Diego CBD, the Mission Valley north of downtown, the area around the University of California's San Diego campus, and smaller clusters spread throughout the western portion of San Diego County.

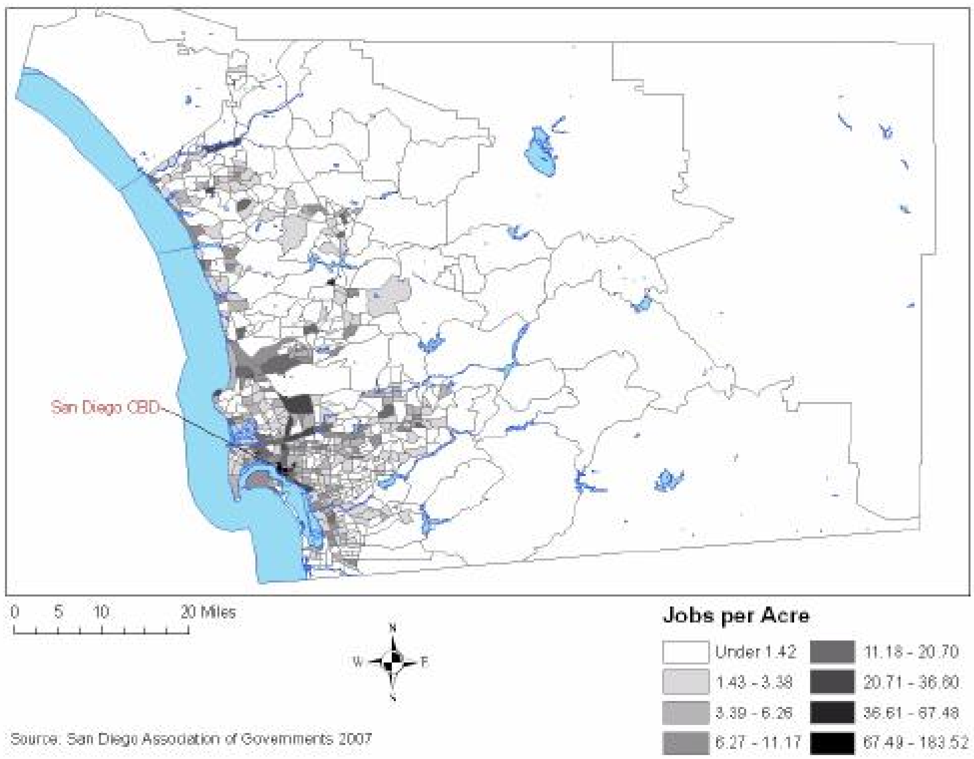


Figure 131 San Diego MSA: employment density by census tract (2000)

The San Diego MSA emerges from this brief examination of population and employment growth and distribution as a growing, decentralized metropolitan area. Both population and employment are decentralized, but there are clear corridors or clusters of population and employment, as shown in both figures. This pattern of potential travel destinations implies the need for a decentralized transit system which provides connections to the major clusters and corridors. The authors discuss the San Diego area's transit system later in the case study.

Institutions and Key Actors

Two public transit agencies and the San Diego area's metropolitan planning organization are the primary actors in transit policy and planning in the San Diego metropolitan area.

Metropolitan Transit System (MTS)

The former San Diego Metropolitan Transit Development Board (MTDB) was responsible for transit development (including planning, design, and construction of major transit infrastructure), service planning, and management of operations for all transit service in the southern part of the county prior to 2005. In 2005 its transit development responsibilities were transferred to the San Diego Association of Governments, and its name was changed to the Metropolitan Transit System (MTS) (Previously, all of the transit services in the MTDB area were branded as the MTS, regardless of which operator actually operated them.) The new MTS continues to own the assets of the San Diego Trolley Inc. (SDTI), the light rail transit operator, and the San Diego Transit Corporation (SDTC), the San Diego area's primary bus operator. MTS also contracts services with Chula Vista Transit (CVT) and operates service formerly provided by National City Transit (NCT). MTS is responsible for service planning and service operation of its own bus and LRT service and contract bus service. MTS is governed by a 15-member appointed board made up of elected officials from member cities' city councils and the County Board of Supervisors and one resident elected by the other board members to serve as chair person.

North County Transit District (NCTD)

The North County Transit District (NCTD) plans, constructs, and operates bus and rail transit systems in northern San Diego County, from Del Mar on the coast and Escondido in the I-15 corridor to the borders with Orange and Riverside Counties. NCTD operates bus service (Breeze) and commuter rail service (Coaster), and will unveil its new light rail transit service (Sprinter) in March 2008. NCTD is governed by a nine-member appointed board made up of one council member from each of the nine member cities plus the member of the San Diego County Board of Supervisors for the geographic area covered by NCTD service.

San Diego Association of Governments (SANDAG)

The San Diego Association of Governments (SANDAG) is the metropolitan planning organization (MPO) for San Diego County. As the MPO, SANDAG approves the short-range Transportation Improvement Program (TIP) and Long Range Transportation Plan (LRTP) required for obtaining federal aid. The study's interviewee reported that SANDAG is involved in long-range transit planning efforts, including the development of a combined land use-transit planning vision.[221] However, this same contact noted that SANDAG's management tends to come from highway backgrounds, so he felt that transit did not have a very strong presence in the organization.

SANDAG is governed by a board consisting of 19 voting members drawn from the mayors and councils of member cities and the County Board of Supervisors, plus non-voting members representing Imperial County, the U.S. Department of Defense, California Department of Transportation (Caltrans), San Diego Unified Port District, Metropolitan Transit System (MTS), North County Transit District (NCTD), San Diego County Water Authority, Southern California Tribal Chairmen's Association, and Mexico.

Transit Agencies, Modes, Fares, and Rider Profiles

The transit system in San Diego County presents a single image to the riding public, and the authors have thus decided to treat it as a single entity. Figure 132 provides a map of the county's transit system. The system includes three light rail transit (LRT) lines, the Coaster commuter rail line, and a mixture of local and express bus services. The earliest LRT line opened in 1981, and the most recent in 2005 (see Table 135). The LRT system totals just under 52 miles. The map shows that the transit system is focused on the major population and employment clusters identified in Figure 130 and Figure 131 shown earlier, and has both grid and radial characteristics.

The adult local bus base fare varies by type of service: shuttle routes ($1.00), local routes ($1.75), NCTD Breeze routes ($2.00), urban routes ($2.25), express routes ($2.50), commuter express ($4.00), and rural routes ($5.00–$10.00).[222] LRT (Trolley) fares range from $1.25 to $3.00 each way, depending on distance traveled. Senior citizens and the disabled are eligible for discounted fares. MTS and NCTD also sell monthly passes, half monthly passes, day passes, and multi-trip tokens. Until January 1, 2008, most transfers were free (within a two-hour window), except in cases where a passenger was transferring to a higher fare service.[223] In such circumstances, passengers were required to pay the differences in the fares when transferring. However, on January 1, 2008, MTS abolished free transfer privileges.

Table 135 San Diego light rail transit segment openings

Year	Segment Length (miles)	Line	Section	Cumulative System Length (miles)
1981	15.9	South Line	Santa Fe Depot–San Ysidro	15.9
1986	4.5	East Line	12th & Imperial Transfer Station–Euclid Avenue	20.3
1989	11.1	East Line	Euclid Avenue–El Cajon Transit Center	31.4
1990	1.6	Bayside Line	Santa Fe Depot–12th & Imperial Transfer Station	33
1995	3.5	East Line	El Cajon Transit Center–Santee Town Center	36.5
1996	3.3	North Line	Santa Fe Depot–Old Town Transit Center	39.8
1997	6.1	Mission Valley West Line	Old Town Transit Center–Mission San Diego	45.9
2005	5.8	Mission Valley East Line	Mission San Diego–Grossmont Center	51.7

Source: Leroy. Demery, *U.S. Urban Rail Transit Lines Opened from 1980*, October 18, 2005. p.25–26.

Note: Mission Valley East Line opened July 10, 2005.

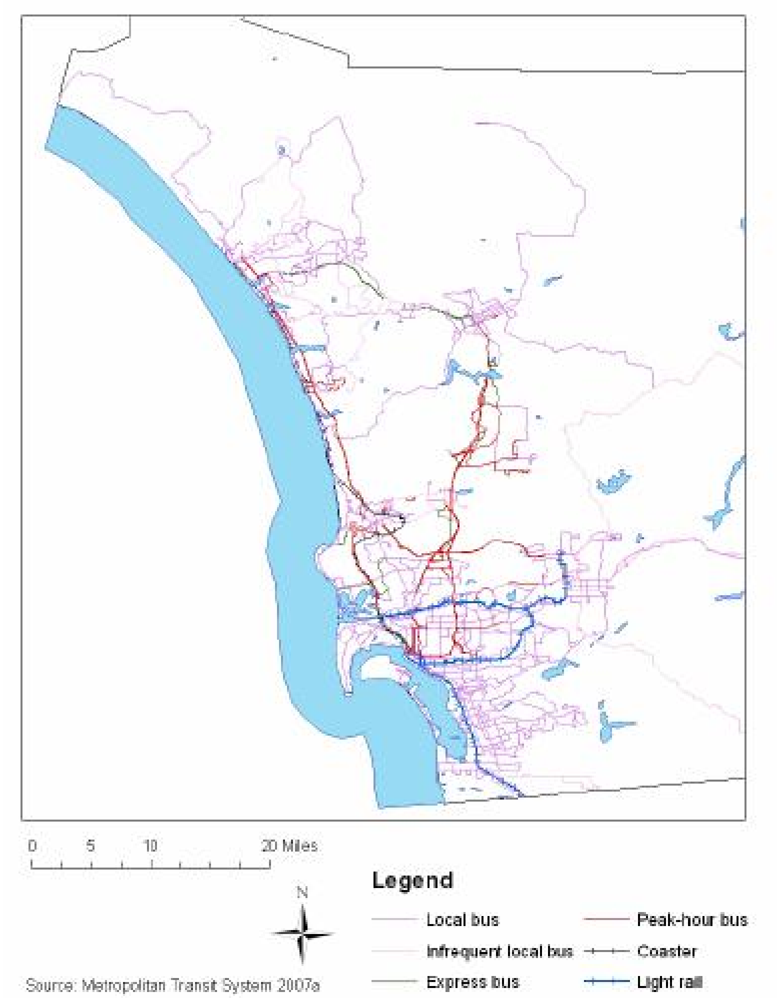


Figure 132 Transit system in the San Diego metropolitan area (2007)

Ridership Profile

In 2003, the SANDAG completed an on-board survey of all 164 fixed-route bus and rail lines in operation at the time of the survey.[224] Their survey included services operated under the following agency names: the San Diego Transit Corporation (SDTC), the North County Transit District (NCTD), San Diego Trolley Incorporated (SDTI, which offers light rail service), National City Transit (NCT), Chula Vista Transit (CVT), the San Diego Metropolitan Transit Development Board (MTDB), and the Coaster (which offers commuter rail service).

Table 136 presents the demographic profile of transit riders in San Diego County that emerged from the survey. The table indicates that there are more females than males on the bus services, but more males than females on the rail services. Nearly three-quarters of San Diego transit riders are characterized as transit-dependent, but there is variation in the proportion of transit-dependent riders carried by the different types of services. Bus services carried a lower-income, more transit-dependent clientele, while rail services carried more higher-income and choice riders.[225]

Table 137 shows that most transit riders accessed their transit vehicle by walking. Fewer than 40% of riders transferred to or from another transit vehicle. More LRT riders (reported under SDTI in the table) transferred than bus riders. Coaster (commuter rail) riders reported the smallest transfer rate.

Table 136 Demographics of San Diego transit riders

Survey Category	Response	Total Percent	Service Percent						
			SDTC	NCTD	CVT	NCT	MDTB	SDTI	Coaster
Gender	Male	48	44	49	44	37	46	55	56
	Female	52	56	51	56	63	54	45	44
Transit dependent	Yes	74	80	84	80	83	78	65	17
	No	26	20	16	20	17	22	35	83
Income	Under $10,000	27	30	29	27	36	28	25	4
	$10,000–$19,999	24	25	21	23	25	24	26	4
	$20,000–$29,999	16	17	14	16	16	18	15	5
	$30,000–$39,000	11	11	12	12	10	12	11	8
	$40,000–$49,999	7	7	8	8	5	7	7	9
	$50,000–$59,999	5	4	5	5	3	4	5	10
	$60,000 or more	10	7	11	9	5	8	11	61

Source: SANDAG. *Results of the Onboard Transit Passenger Survey for the San Diego Region,* March 2004, p. 20, 29, 34.

Table 137 Access and egress methods used by San Diego transit riders

How did you get to this bus/trolley/Coaster? After you get off this bus/troller/Coaster will you?	Total Percent	Service Percent						
		SDTC	NCTD	CVT	NCT	MTDB	SDTI	Coaster
Walk	54	63	58	54	49	55	43	23
Transfer	38	34	35	43	47	39	44	21
Drive alone	3	1	1	0	0	1	6	30
Drop off/carpool	4	2	4	3	2	3	6	13
Other	1	1	2	0	1	1	1	13

Source: SANDAG, *Results of the Onboard Transit Passenger Survey for the San Diego Region*, March 2004, p.19.

ANALYSIS

Regional Transit Vision

The vision for transit development in San Diego emerged during the 1970s as an outgrowth of inter-jurisdictional fighting over transit development. The City of San Diego created the first major transit institution in the region by forming a city-owned corporation to take over the failing private bus company in 1967. A strike shortly thereafter continued the downward spiral of patronage, but the emergence of new sales tax funding with the passage of the Transportation Development Act in 1971 led to major service expansion and fare cuts. Then the first energy crisis hit. Patronage doubled within a couple of years. These developments occurred in the absence of vision as to what objectives the transit system should be serving. The vision was to come shortly, however.[226]

In 1975, the San Diego Transit Corporation (SDTC) unveiled its *Action Plan*, which called for a 63% additional service expansion. A network of express bus routes was to be created that focused on the San Diego CBD from the north, east, and south. The buses would operate on freeways for the most part, but they would leave the freeways at major activity centers to serve them. In addition, SDTC proposed starting circulator routes operated with mini buses that would connect with the express buses at their intermediate stops and circulate through the major activity centers and nearby neighborhoods. (About 63 Mercedes mini buses were purchased for the purpose.)

The *Action Plan* was applauded by UMTA and others as visionary and a model for the industry, and it largely was implemented. Its implementation did not go well, however. Operating costs rose more than commensurate with the increase in service, because for several years the unit costs of running SDTC buses were growing at more than double the roughly 7% annual inflation rate that characterized the 1970s. There was little demand for the new service. Although most express buses operated in both directions all day long with either half hourly or hourly headways, and they offered evening and weekend service, as well, few passengers rode them. Most of the express buses carried fewer than 1,000 passengers per day. The Mercedes shuttle buses ran around largely empty. The initial performance of the shuttles was so poor that SDTC was forced into not implanting some of the shuttles, and many of the 60 shuttle buses never were placed into service. Operating cost increases outstripped growth in subsidy sources, including the lucrative TDA funds, and by 1976 SDTC was forced to raise fares and start cutting out some of its most unproductive services.

During this same time the predecessor to SANDAG, the Comprehensive Planning Organization (CPO), unveiled plans for a 59-mile regional rapid transit system serving the southern part of the county. Similar in concept to the Washington Metro or the Bay Area Rapid Transit System, the proposed regional rail system in San Diego was to be supplemented by a roughly 700 bus system. (SDTC was operating about 250 buses during the peak of bus operations in 1975.) CPO also called for a land use policy that placed most of the region's projected population and employment growth in the vicinity of rail stations, implying a major redevelopment of the then-existing urban fabric. Its models projecting demand for transit services in the future reflected the transit-supportive land use policy.

In order to be implemented, the CPO plan required tremendous local support, which unfortunately largely was absent. The models indicated a roughly 13% transit peak period mode split in the southern part of the county which did seem to many not to warrant the major expense of the system. At the same time, SDTC's 250-bus system seemed largely irrelevant but nonetheless too costly to maintain. No one knew how CPO's land use vision could be brought about; local jurisdictions that had regulatory control over land use development did not stand behind the CPO concept. CPO could not obtain regional consensus behind a bill to create a regional transit agency to design the system and come up with a plan to finance it, and the bill died in the legislature in 1975.

At that time a third institution was created to engage the transit debate. The lead author of the Transportation Development Act, James R. Mills, was the president pro tempore of the California State Senate and also represented San Diego. Senator Mills had a vision for regional transit development in San Diego based on light rail transit, something that could be accomplished modestly, quickly, and within the envelope of available funds. He authored a bill to create the San Diego Metropolitan Transit Development Board (MTDB) to carry out such a vision, and the bill became law in 1975, with MTDB coming into existence the following year. Its board was composed of the mayor of San Diego, three members of the San Diego City Council members, two other city council members from smaller cities in its area of jurisdiction, a member from the San Diego County Board of Supervisors, and a member appointed by the governor.

MTDB was given broad powers to carry out its mission, including authority to develop transit infrastructure in its area, authority to allocate TDA funds to transit operators or to capital improvements, authority to spend state gas tax money on the building of rail lines, and authority to take over the actual operations of transit systems, and if not utilizing that authority, authority to oversee the coordination and provision of their services and fares. Despite such authority, MTDB faced considerable skepticism in the community and on its own board about the viability of rail transit in a car-dominated, freeway-interlaced region, such as San Diego. To proceed, it needed a vision upon which the Democrat Jim Mills, the Republican Mayor Pete Wilson (who was chair of the MTDB Board), and others could agree.

The vision that MTDB's first general manager, Bob Nelson, ultimately offered up, and upon which all ultimately agreed, was that a low-cost, high level-of-service light rail line would be built in the corridor that CPO identified as having the highest ridership demand, and that the light rail line would be used as a tool for improving the productivity of the overall transit system in the region. The light rail line would do this by replacing the duplicative trunk portions of bus routes running to the CBD with high capacity trains. The remaining parts of the bus routes would tie into the rail stations, where transfers would be possible not only between bus and rail, but between bus and bus. Buses would feed light rail. Light rail would feed buses, so that rail patrons could reach destinations that were not in the CBD, and buses would feed each other. The MTDB financial plan showed that if the city could control the unit costs of San Diego Transit by not allowing wage increases for two years, and then having wages per hour increase by 5.5% per year rather than 7% per year for the next fifteen years, the region could build the light rail line, integrate bus services around it, and double the number to transit vehicle miles operated in the region with no increase in taxes. (This promise was made in 1978, the year that Proposition 13 passed.) This was the vision that MTDB offered the region, and the region embraced it.

To a large extent, MTDB carried out its promise. Service did double without a need for additional tax support. Patronage more than doubled. Productivity did improve. What differed from the regional vision, which is shown in Figure 133, is that the only regional trunk routes that were developed were those where the region decided to build light rail lines. Figure 133 shows only one rail line, the original line from the CBD to the international border, which opened in 1981. The other trunk routes were envisioned as bus rapid transit, with on-freeway stations, as shown in Figure 134. As it turned out, however, several of the routes shown in the SCE were developed as light rail lines, while the remaining regional trunk lines in the Service Concept Element were not developed as intensively as envisioned. Bus service was established in these corridors, but there were no on-freeway stations. The rail lines include the line from the CBD to El Cajon and ultimately to Santee, as well as the line from the CBD to the northwest. The northwest rail line terminates at Old Town rather than at Loma Portal as shown in the Service Concept Element. (Old Town is less than a mile east of Loma Portal.) The east-west line through the Mission Valley also was converted to light rail. Figure 135 shows an actual light rail station in the Mission Valley (at Hazard Center), which may be contrasted to the conceptual bus freeway station shown in Figure 134. The latter would have served the same general area in the Mission Valley.

A characteristic of the regional transit vision in San Diego, at least until the reorganization of 2003, is its embracing of the operation of numerous transit operators within the region. The numerous operators have been coordinated by the MTDB to function as a cohesive regional transit network in the eyes of the users.[227] The authors' contact described the original regional vision as being to improve transit service and coordinate different transit entities, countywide. After passage of the Transportation Development Act, many communities started their own transit systems (such as Chula Vista Transit, National City Transit, and North County Transit). There were many of these small transit systems but little coordination between them. The state of California created the Metropolitan Transit Development Board (MTDB), forerunner of MTS, in 1975 both to develop a guideway transit system and to coordinate the various transit systems in the southern part of the county. MTDB also unified the route numbers and produced a single regional transit map in coordination with North County Transit.

The study's interviewee agreed with the authors' characterization that MTDB tried to take transit to land use, as opposed to waiting for land use to develop around transit.[228] The development of the LRT (the Trolley) in 1981 was an important part of this strategy, which was promoted by people in both SANDAG and MTDB and given political support by State Senator Jim Mills (father of California's Transit Development Act). The LRT (Trolley) itself was developed to be a low-cost, reliable, utilitarian transportation system. By the mid-1980s, the study's interviewee noted that San Diego had really started to expand the role of transit in the region.

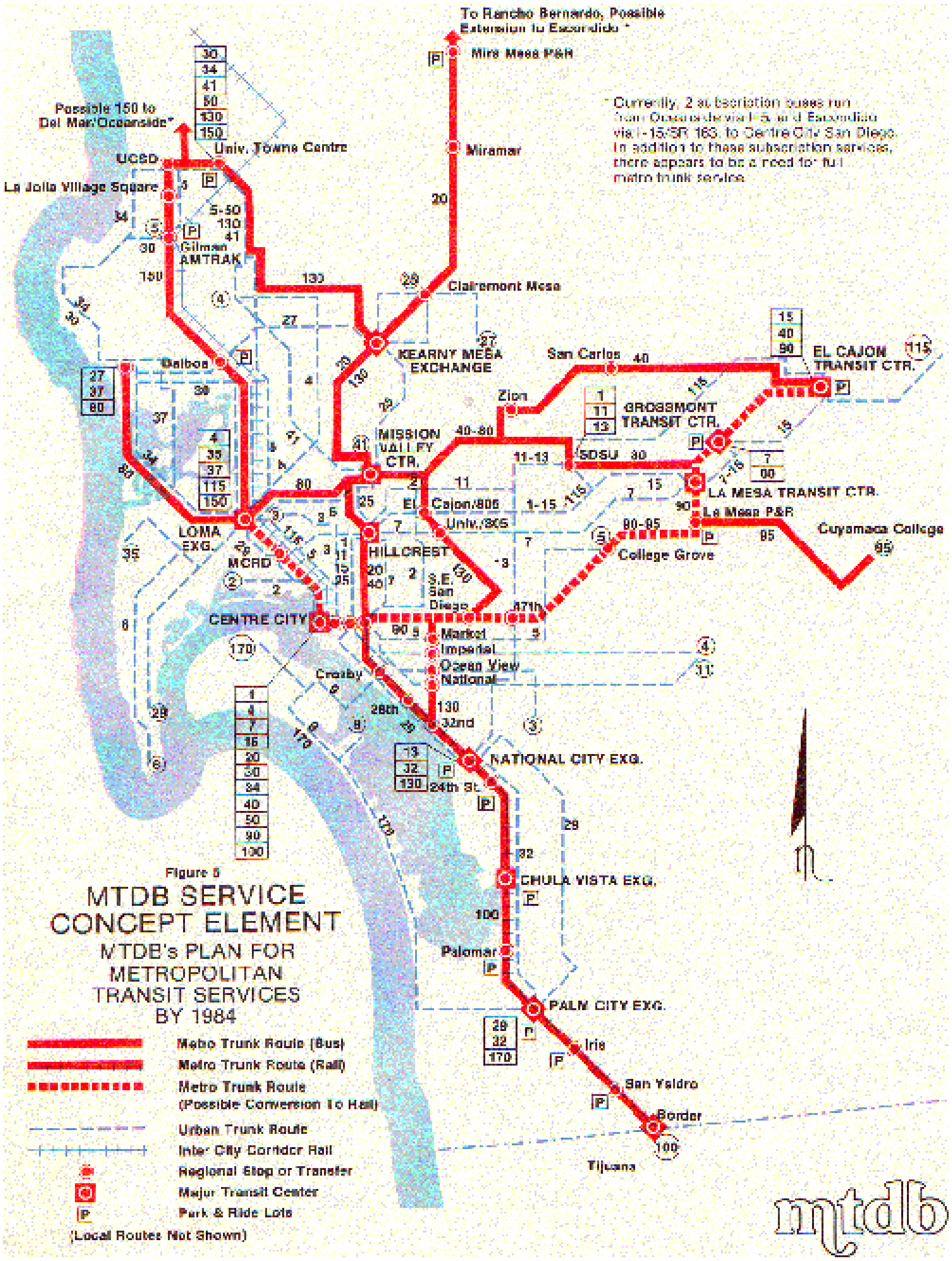


Figure 133 San Diego MTDB service concept element (1979)

Figure 134 On-freeway bus station from 1979 service concept element

Source: MTDB 1979

Figure 135 LRT station in Mission Valley (2002)

Source: Author

Over time, the link between transit and land use has emerged as an important part of the regional transit vision. SANDAG has long tried to promote transit-supportive development. The study's interviewee himself developed pro forma in the 1980s to get developers interested in developing around transit stations in a more transit-supportive manner. By the late 1980s, people became very receptive to New Urbanist ideas and even brought in famed new urbanist Peter Calthorpe to design a transit-oriented development (TOD) project at Rio Vista.

The Mission Valley line was the first one that in a substantial way coupled land use and transportation. In this corridor, the city of San Diego encouraged developers to pledge right of way for LRT and pay for LRT stations. The interviewee cited Rio Vista, the Park in the Valley shopping center, and the Hazard Center as particularly important examples of development linked to transit. The study's contact characterized both the development and ridership in this corridor as doing well, although he does not think people are using the LRT as much as planners had hoped to access commercial and office development.

In the late 1990s, MTDB began to develop a combined transit-land use vision for the region. This vision was called Transit First. Transit First showed what a future transit system might look like, and included a proposed route map. The route map featured four classes of transit routes: Red Car (high speed, one mile stop spacing, equivalent to trolley but could also be offered by bus), Yellow Car (cross-regional service via commuter railroad or bus), Blue Car (local bus), and Green car (shuttles). This map served as a template, and was used to reauthorize the dedicated transit sales tax several years ago. SANDAG then examined land use patterns and began to work with local communities to try to achieve the combined land use and transit plan outlined in the vision. The study's contact says this effort was warmly received, but he fears that momentum behind this effort has been lost in recent years.

Regional Transit System Structure and Function

The study's interviewee observed that only 5% of regional trips have an origin or destination in downtown San Diego and this information has influenced the design of the transit system, including the use of timed-transfer points, the restructuring of former trunk bus routes as LRT feeders, and the development of cross-regional bus services.[229] He reports that the bus system has been restructured as LRT segments have opened. The contact observes that a major reason for the restructuring of buses as feeders to LRT was to achieve operating efficiency gains. Bus ridership has grown when such changes to routes are made. The ability to use the restructuring to expand riders' ability to access more travel destinations began as a secondary objective, but has since become co-equal with enhancing efficiencies.

However, the restructuring has not been as extensive as the study's contact would desire. He noted that capacity analysis has revealed that many CBD-bound buses have lots of capacity, because riders transfer to the LRT as opposed to continuing by bus to the CBD. He noted that he had wanted long-distance CBD-bound routes truncated at LRT stations, and only shorter distance routes to penetrate the CBD. MTS has recently reduced service on many of its CBD-serving routes. MTS recently completed a comprehensive operational analysis and has begun making changes to some of its routes.

LRT has been a major emphasis of the transit system in San Diego, but there are efforts to deploy other types of premium services, including commuter rail and bus rapid transit. The interviewee thinks commuter rail has been successful in generating ridership. He noted that the Sorrento Valley stop has second highest number of riders. At this location, a fare-free shuttle service (six routes operated with vans) loops around the area moving people between the stations and workplace destinations. Providing connectivity between major trunks and final destination is also an issue in the Interstate 15 corridor, where the contact believes a similar shuttle service might also be appropriate.

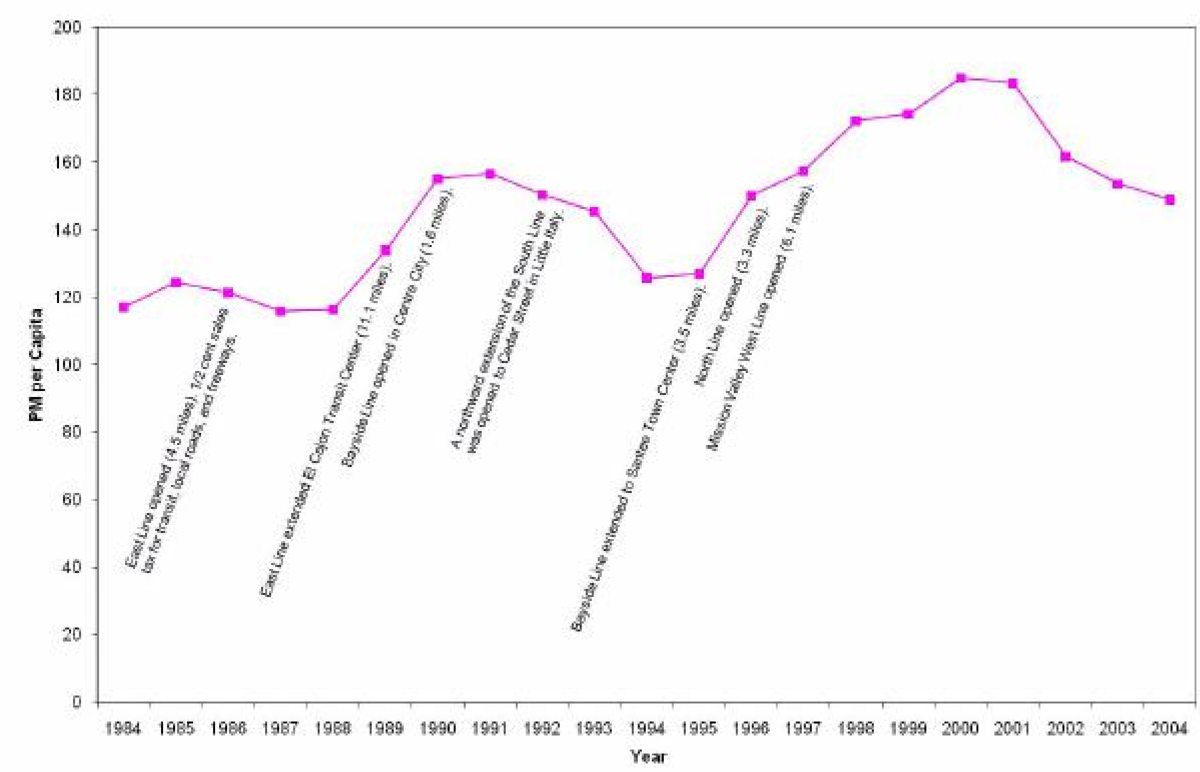
Bus rapid transit (BRT) has emerged as the bus-version of Red Car service outlined in the Transit First vision. On arterial roads, BRT will operate in mixed-traffic lanes with limited stops and signal preemption technology, similar to the Metro Rapid service in Los Angeles. In a few places, there are plans for more expensive BRT projects, including in the Interstate 15 corridor and in the Sorrento Mesa area, although the authors' contact is not sure that the projects will ever materialize. In the Interstate 15 corridor, MTS has tried to tap into a Caltrans plan to add two lanes to the freeway HOV facility. Here, BRT would require drop ramps to access road-side stations. The project description suggests much heavier engineering with greater horizontal distances to destinations (particularly on the far side of the freeway) and vertical climbs to pedestrian bridges than shown in the early SCE on-freeway bus station concept (Figure 134). It is thus likely that the on-freeway bus stations, if developed, will be more expensive and much less useful to transit users than originally thought. In Sorrento Mesa and other north city areas, there are proposals to use elevated guideways for buses to avoid congestion.

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

Both riding habit (measured as passenger miles per capita) and service productivity (measured as passenger miles per vehicle mile, or load factor) have increased in the San Diego metropolitan area since 1984. Figure 136 displays riding habit between 1984 and 2004. Overlaid on the chart are important service or fare changes that might be expected to influence riding habit. The figure shows that the riding habit trend has been upward, with major increases occurring in the late 1980s-early 1990s and again in the late 1990s. These periods correspond with the opening of LRT segments shown in Table 135 earlier in the study.

Figure 137 displays service productivity over the same period. Service productivity increased slightly between 1984 and 2004, in stark contrast to the decline in productivity experienced in most cities. The service productivity peaks correspond with the riding habit peaks and rail segment openings noted on the preceding figure. This suggests that the service changes, including route restructuring, which accompanied the opening of LRT segments, was very effective.



Source: U.S. Census Bureau 2006, Florida Department of Transportation 2006

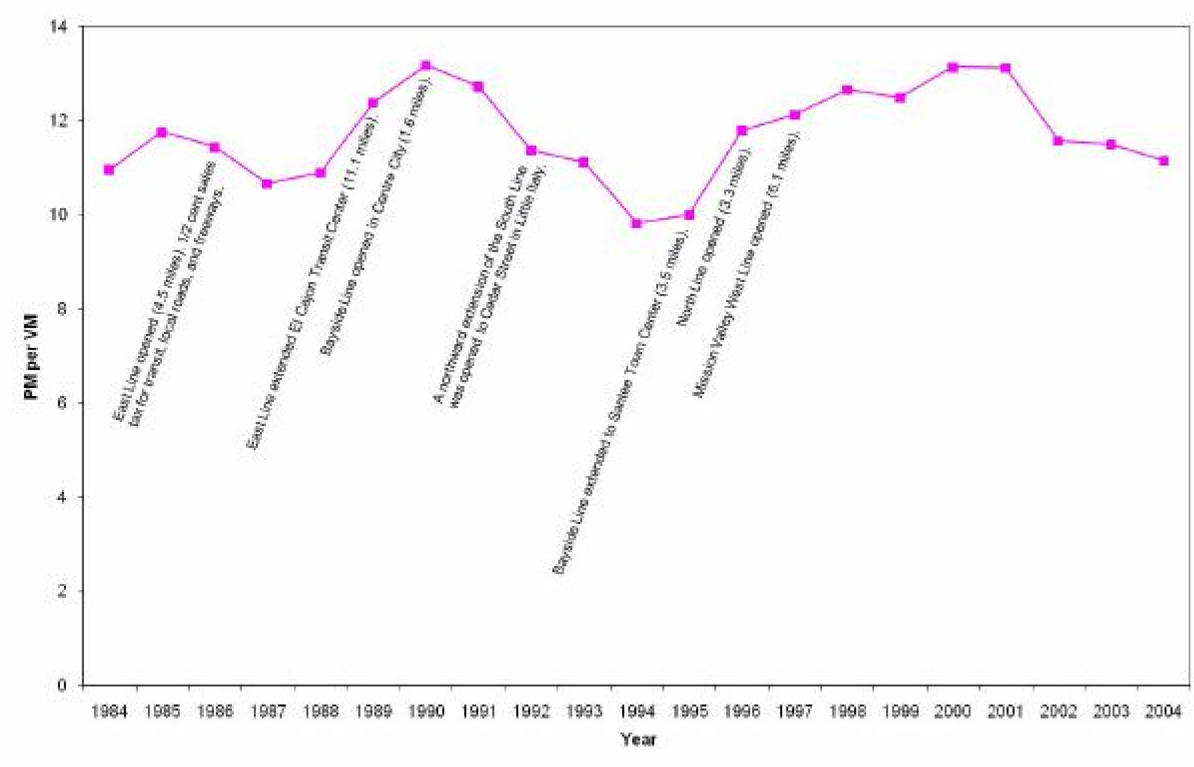
Figure 136 San Diego MSA riding habit (passenger miles per capita) (1984–2004)

System Ridership and Productivity Trends

Table 138 reports ridership by travel mode from 1984 to 2004. Ridership is reported on both passenger mile and (unlinked) passenger trip, or boarding, bases for bus, light rail, commuter rail, and all transit modes combined. The table shows that bus ridership has increased since 1984, with the increase in unlinked passenger trips outpacing the increase in passenger miles. This is indicative of declining average bus trip lengths, as shown in Table 139. The decline in bus passenger trip length is consistent with the notion that many passengers now make the trunk part of their trip on rail lines.

Light rail patronage also increased from 1984 to 2004, with the growth in unlinked passenger trips outpacing the growth in passenger miles (see Table 138). The result is again a decrease in average trip length (see Table 139). Finally, commuter rail patronage has also increased, although in this case average trip lengths have increased very slightly.

The overall upward trend in transit ridership obscures several patronage peaks and valleys. Transit ridership experienced peaks in both the late 1980s-early 1990s and the late 1990s, with declines immediately thereafter. Over the past few years, bus ridership has declined, while both light rail and commuter rail ridership have increased. The net effect of these diverging trends has been a decline in overall patronage, measured on both passenger miles and unlinked passenger trips bases.



Source: Florida Department of Transportation 2006

Figure 137 San Diego MSA load factor (passenger miles per vehicle mile) (1984–2004)

Transit agencies in the San Diego metropolitan area have increased service dramatically since 1984. Table 140 reports service (measured as vehicle miles) by mode and for all modes combined. Bus service has increased steadily from 20.4 million vehicle miles in 1984 to 32.5 million vehicle miles in 2004, an increase of more than 60%. The bus service increase has far outpaced the bus ridership increase, resulting in reduced bus service productivity (measured as passenger miles per vehicle mile, or load factor) (see Table 141).

Light rail service has also increased dramatically, as a function of the extension of the system from approximately 16 miles in 1984 to nearly 52 miles today (see Table 135). Light rail service productivity has fallen as the system expanded, but has increased in the past few years (see Table 141). Commuter rail service has also increased, while commuter rail service productivity has fluctuated the past several years. Both light rail and commuter rail service declined slightly after experiencing peaks earlier this decade.

The net result of the modal service changes is a near doubling in the total amount of service provided by transit agencies in San Diego. Table 141 shows that overall service productivity is higher in 2004 than it was in 1984, although it has declined from its 2000–2001 peak.

Table 138 Ridership on San Diego MSA fixed-route transit systems (1984–2004)

Year	Bus		Light Rail		Commuter Rail		Total Transit	
	Passenger Miles	Passenger Trips	Passenger Miles	Passenger Trips	Passenger Miles	Passenger Trips	Passenger Miles	Passenger Trips
1984	195,943,992	36,670,298	46,221,569	5,381,670			242,165,561	42,051,968
1985	209,641,082	38,548,211	46,221,569	5,381,670	8,813,090	341,288	264,675,741	44,271,169
1986	212,333,486	39,097,081	46,221,569	5,381,670	8,125,102	256,246	266,680,157	44,734,997
1987	197,024,652	36,775,791	57,491,777	8,946,700	9,250,383	270,360	263,766,812	45,992,851
1988	201,083,891	38,261,963	63,535,246	9,280,616	10,375,664	284,473	274,994,801	47,827,052
1989	241,422,141	45,528,741	75,936,591	11,216,631	10,121,274	264,369	327,480,006	57,009,741
1990	258,193,755	51,209,127	115,518,215	15,933,546	16,110,500	255,132	389,822,470	67,397,805
1991	267,782,479	53,607,155	122,971,867	18,029,990	9,092,028	177,580	399,846,374	71,814,725
1992	265,836,871	55,798,667	116,190,464	17,162,550	7,785,568	194,540	389,812,903	73,155,757
1993	258,546,564	55,603,348	111,735,458	16,504,499	n.a.	n.a	370,282,022	72,107,847
1994	247,114,928	52,837,142	75,619,679	14,887,952	n.a..	n.a	322,734,607	67,725,094
1995	248,996,468	54,319,919	79,362,930	15,624,410	4,843,024	177,733	333,202,422	70,122,062
1996	265,462,266	58,827,569	111,522,867	16,770,356	20,729,670	741,030	397,714,803	76,338,955
1997	276,482,473	63,179,012	121,605,996	18,286,616	25,747,918	909,974	423,836,387	82,375,602
1998	292,109,672	69,182,853	152,745,240	22,969,209	26,886,217	938,016	471,741,129	93,090,078
1999	291,073,644	70,930,933	160,671,313	24,567,479	34,721,400	1,240,225	486,466,357	96,738,637
2000	300,161,935	71,333,816	188,268,785	28,743,326	33,852,130	1,187,751	522,282,850	101,264,893
2001	301,294,874	71,136,476	189,200,379	28,885,554	34,394,930	1,206,839	524,890,183	101,228,869
2002	282,147,352	68,495,824	150,308,746	25,432,952	36,371,110	1,281,124	468,827,208	95,209,900
2003	263,777,768	65,145,178	159,356,408	25,174,788	37,867,481	1,348,453	461,001,657	91,668,419
2004	236,660,489	58,623,547	170,375,494	26,538,239	40,392,713	1,428,819	447,428,696	86,590,605

Source: Florida Department of Transportation 2006.

Table 139 Average trip lengths (San Diego) (1984–2004)

Year	Average Trip Length (miles)			
	Bus	Light Rail	Commuter Rail	Total
1984	5.34	8.59		5.76
1985	5.44	8.59	25.82	5.98
1986	5.43	8.59	31.71	5.96
1987	5.36	6.43	34.22	5.73
1988	5.26	6.85	36.47	5.75
1989	5.30	6.77	38.28	5.74
1990	5.04	7.25	63.15	5.78
1991	5.00	6.82	51.20	5.57
1992	4.76	6.77	40.02	5.33
1993	4.65	6.77	n.a.	5.14
1994	4.68	5.08	n.a.	4.77
1995	4.58	5.08	27.25	4.75
1996	4.51	6.65	27.97	5.21
1997	4.38	6.65	28.30	5.15

Table 139 Average trip lengths (San Diego) (1984–2004)

Year	Average Trip Length (miles)			
	Bus	Light Rail	Commuter Rail	Total
1998	4.22	6.65	28.66	5.07
1999	4.10	6.54	28.00	5.03
2000	4.21	6.55	28.50	5.16
2001	4.24	6.55	28.50	5.19
2002	4.12	5.91	28.39	4.92
2003	4.05	6.33	28.08	5.03
2004	4.04	6.42	28.27	5.17

Source: Florida Department of Transportation 2006.

Table 140 San Diego fixed-route transit service (1984–2004)

Year	Vehicle Miles			
	Bus	Light Rail	Commuter Rail	Total
1984	20,430,284	1,676,744		22,107,028
1985	20,589,579	1,676,744	250,976	22,517,299
1986	21,252,600	1,834,412	250,976	23,337,988
1987	22,390,592	2,082,757	287,551	24,760,900
1988	22,782,104	2,140,758	324,125	25,246,987
1989	23,706,162	2,414,822	341,316	26,462,300
1990	24,916,939	4,096,677	575,201	29,588,817
1991	26,529,798	4,681,314	234,823	31,445,935
1992	29,501,800	4,553,486	260,389	34,315,675
1993	29,295,265	4,455,187	n.a.	33,750,452
1994	29,089,219	4,179,836	n.a.	33,269,055
1995	29,051,946	4,052,981	207,548	33,312,475
1996	28,776,548	4,219,503	748,614	33,744,665
1997	28,934,592	5,178,004	834,860	34,947,456
1998	29,912,262	6,359,517	1,028,123	37,299,902
1999	30,757,129	7,063,116	1,136,791	38,957,036
2000	31,482,251	7,166,547	1,121,976	39,770,774
2001	31,705,379	7,133,382	1,147,912	39,986,673
2002	32,190,121	7,113,223	1,254,151	40,557,495
2003	32,255,795	6,987,564	1,324,460	40,567,819
2004	32,456,676	7,078,660	1,190,643	40,725,979

Source: Florida Department of Transportation 2006.

Table 141 San Diego service productivity, measured in passenger miles per vehicle miles (1984–2004)

Year	Bus	Light Rail	Commuter Rail	Total
1984	9.59	27.57		10.95
1985	10.18	27.57	35.12	11.75
1986	9.99	25.20	32.37	11.43
1987	8.80	27.60	32.17	10.65
1988	8.83	29.68	32.01	10.89
1989	10.18	31.45	29.65	12.38
1990	10.36	28.20	28.01	13.17
1991	10.09	26.27	38.72	12.72
1992	9.01	25.52	29.90	11.36
1993	8.83	25.08	n.a.	10.97
1994	8.50	18.09	n.a.	9.70
1995	8.57	19.58	23.33	10.00
1996	9.22	26.43	27.69	11.79
1997	9.56	23.49	30.84	12.13
1998	9.77	24.02	26.15	12.65
1999	9.46	22.75	30.54	12.49
2000	9.53	26.27	30.17	13.13
2001	9.50	26.52	29.96	13.13
2002	8.77	21.13	29.00	11.56
2003	8.18	22.81	28.59	11.36
2004	7.29	24.07	33.93	10.99

Source: Florida Department of Transportation 2006.

Bus Route Performance Analysis

The authors were able to obtain detailed route-based service and ridership data for all bus routes in San Diego for fiscal year 2006. The service data included revenue miles and revenue hours, while ridership data included average weekday unlinked passenger trips and, through the agency's comprehensive operational analysis, boardings and alightings by bus stop. They used the service and ridership data to develop two general measures of route performance: (unlinked passenger) trips per revenue hour and (unlinked passenger) trips per revenue mile. The authors examined route performance on both measures after classifying routes into groups based on whether or not the route served the San Diego CBD and whether the route provided local or express service.

Table 142 presents the results of the bus route performance analysis. The table reports the median values on both performance measures for different classes of routes. The table indicates that San Diego has strong performance for all types of routes. CBD-serving routes outperform their non-CBD counterparts, while local routes outperform express routes. However, as will be discussed below, many patrons on CBD-serving routes are accessing non-CBD locations.

Overall, San Diego's bus route performance statistics compare quite favorably with the other study cities.

Table 142 San Diego average weekday bus route performance (FY 2006)

Route Type	Number of Routes	Trips per Revenue Hour (median)	Trips per Revenue Mile (median)
All bus routes	157	27.40	1.75
All bus routes serving the CBD	31	30.90	1.89
Express routes serving the CBD	10	29.80	1.31
Local routes serving the CBD	21	32.10	2.35
All bus routes not serving the CBD	126	26.70	1.69
Express routes not serving the CBD	6	22.00	0.97
Local routes not serving the CBD	120	27.00	1.80

Source: SANDAG 2006.

Rail Line Performance Analysis

The authors also obtained ridership and service data for 2006 for San Diego's three light rail transit (LRT) lines and the Coaster commuter rail service, as well as monthly time series data for the three light rail lines from July 2002 through December 2007. These data allowed the authors to calculate three performance measures for 2006: (unlinked passenger) trips per revenue hour, (unlinked passenger) trips per revenue mile, and passenger miles per vehicle mile (load factor). The data also allowed the authors to more examine trends in light rail ridership more closely than is possible through the National Transit Data Base.

Table 143 presents the results of the performance analysis for 2006. The table shows that all the rail services are strong performers. Among the LRT lines, the Blue Line, which currently runs from the international border at San Ysidro through the CBD to Old Town stands out as being much more productive than the others. The Blue Line from the CBD south serves what CPO identified as the most heavily traveled corridor during its rapid transit studies of 1974–75. The part of the Blue Line from the CBD to Old Town has high patronage, because it truncates a large number of bus lines at the Old Town Transit Center. Prior to the Blue Line being extended to Old Town, most of the bus lines that it truncated previously operated to the CBD.

The other two light rail lines serve very different markets. The Orange Line connects east county points to a transfer center with the Blue Line just south of the CBD, and to the CBD itself. The transfer station with the Blue Line is the second most heavily used stop in the region because of the very heavy transfer movements from the south to the east, and from the east to the south. (Passengers accessing the new baseball stadium now use this stop as well, but the passenger figures reflect pre-stadium conditions when almost all of the stop's users were making transfers between the two light rail lines.) The line also serves a smaller transfer center at Euclid Avenue, about five miles east of the CBD where it intersects with north-south bus routes, and a major transfer center (along with the Green Line) at its eastern end in El Cajon.

The Green Line is an east-west crosstown serving largely auto-oriented commercial development. It spans the mid-county, starting from the Old Town Transit Center on the west (where it intersects with the Blue Line, the Coaster, and a large number of bus routes fanning into the center from the north, west, and southwest). It continues to El Cajon and Santee on the east. In between it serves intense mall, big box, office building hotel/motel, apartment and condominium complexes, as well as San Diego State University. Stations at Fashion Valley Mall, San Diego State University, and El Cajon Transit Centers also are major transfer hubs with numerous bus lines. The Orange Line also serves the El Cajon Transit Center.

While the Orange Line carried more ridership than the Green Line in 2006, it now appears that the Green Line patronage has overtaken that of the Orange Line. Green Line patronage fluctuates widely from month to month, because of sports events at Qualcom Stadium, which it serves conveniently, but a 12-month moving average of its patronage reveals a steadily rising secular trend in its patronage (see Figure 138).

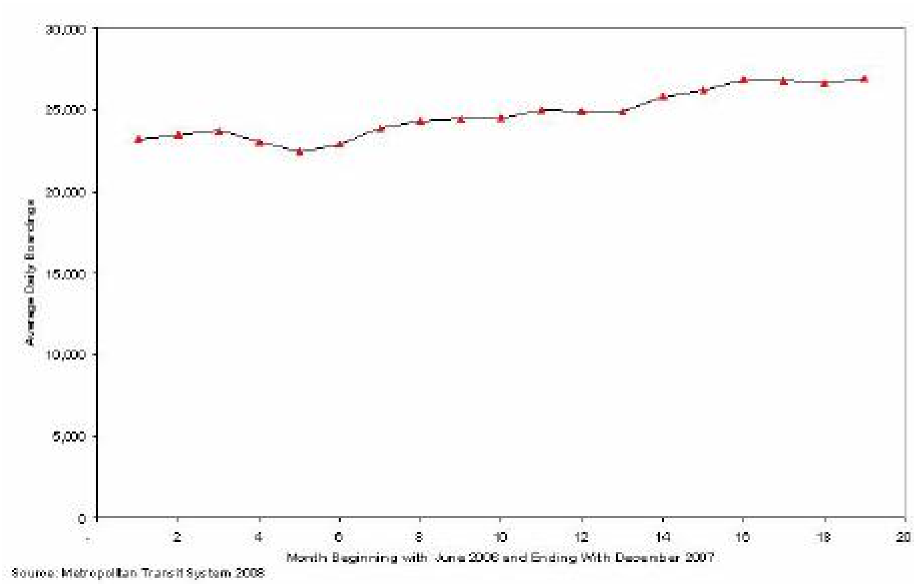


Figure 138 San Diego Green Line LRT 12-month moving average daily boardings

The Importance of the CBD for Transit Ridership

As noted earlier, most transit routes in the San Diego region enjoy relatively high productivity, but those serving the CBD generally have higher productivity than others. This fact suggests that the CBD exerts a modest positive effect on transit performance. It is important to understand, however, that most of the transit ridership even on the routes going to the CBD is not destined to the CBD. During the morning peak period, most patrons using routes going to the CBD get off their transit vehicles before the vehicles reach the CBD, or they ride completely through the CBD and alight at destinations far beyond it. This result is evident from Table 144, which shows the pattern of passenger alightings for all of those passengers using transit routes that went to or through the CBD in 2006.

The result applies to all transit modes, including express buses and the Coaster commuter rail. Most express bus passengers go to destinations other than the CBD. This pattern also prevails on the Coaster commuter rail line. For the latter, almost all morning peak passengers alighted at three stops: Sorrento Valley, Old Town, and the CBD. On average each morning, 787 passengers alighted at Sorrento Valley evidently destined to high-tech destinations there or to the University of California at San Diego, located on the mesa above Sorrento Valley. Another 347 passengers on average alighted at Old Town, where they could connect to the Green Line trolley going east through the Mission Valley, or to many bus routes destined to all of the surrounding areas. Finally, 670 passengers alighted in the CBD. It also is clear from the table that the trolley gains its strength only in small part from the CBD. The many other destinations that it serves in aggregate contribute to most of its patronage.

Table 143 San Diego rail line average weekday performance (FY 2006)

Rail Line	Trips per Revenue Hour	Trips per Revenue Mile	Passenger Miles per Vehicle Mile
Blue Line (LRT)	333.40	15.74	102.99
Green Line (LRT)	172.30	6.92	38.82
Orange Line (LRT)	182.60	8.92	50.39
LRT Total	**242.65**	**11.11**	**68.34**
Coaster	227.30	5.56	152.69

Source: SANDAG 2006.

Table 144 Morning peak period passenger alightings for San Diego CBD-serving routes

Location	Type of Service			
	Trolley (LRT)	CBD-Serving Express Bus	Coaster (commuter rail)	CBD-Serving Local Bus
Inside CBD	6,687	400	670	2,517
Outside CBD	13,000	2,349	1,447	8,254
Total	19,687	2,749	2,117	10,771

Source: San Diego Association of Governments, Transit Passenger Counting Program. Figures calculated from boardings and alightings of individual routes identified as serving CBD, FY 2006 data. Downloaded from http://pcp.sandag.org/Home.aspx, Fall 2007.

The Importance of Network Connectivity and Transferring

The on-board transit survey discussed earlier shows that a relatively small part of the San Diego region's patronage transfers between transit vehicles. This survey finding does not comport with the data that the authors have been presenting, where the transit stations of greatest activity, the transit lines of largest patronage and greatest growth, all are related to high levels of transfer activity.

Further evidence pointing to a high level of transfer activity in the region is contained in Table 145, which shows the 20 largest transit stops in the region in terms of week day usage in both 2005 before the Green Line opened, and 2006 after it opened. The station with the highest use after the opening is that at Old Town, already identified as a major transfer station between bus, light rail, and commuter rail. It also has a large park and ride lot, but the fact that usage in the station grew 50% in one year with the opening of the Green Line suggests heavy transfer movements. The second busiest station is at 12th and Imperial, which is where passengers transfer off the Blue Line to head east on the Orange Line, or they transfer of the Orange Line to head south on the Blue Line. Before the opening of the nearby ball park, there was little other reason to use this station.

Table 145 San Diego top 20 transit stops in fiscal year 2005 and fiscal year 2006

Stop	FY 2005 Rank	FY 2006 Rank	FY 2005 Trip Ends	FY 2006 Trip Ends	Percent Change 2005–2006
Old Town Transit Center	2	1	20,574	31,958	55.33
12th and Imperial Station	1	2	20,639	21,858	5.91
International Border Station	3	3	19,849	20,949	5.54
Iris Avenue Trolley Station	4	4	14,977	15,431	3.03
H Street Trolley Station	5	5	11,972	12,210	1.99
5th Avenue Station–C Street	6	6	11,034	11,182	1.34
El Cajon Transit Center	1	1	78,799	10,935	24.28
Euclid Trolley Station	7	8	10,381	10,622	2.32
City College Station	8	9	10,243	10,565	3.14
Fashion Valley Trolley Station	10	10	9,347	10,072	7.76
Palomar Street Trolley Station	9	11	9,988	9,483	-5.06
Civic Center Station	12	12	8,351	7,644	-8.47
24th Street Trolley Station	14	13	7,656	7,583	-0.95
American Plaza	13	14	7,938	7,170	-9.67
Escondido Transit Center	16	15	6,629	7,157	7.97
San Diego State University	36	16	2,281	6,968	205.48
Vista Transit Center	15	17	6,747	6,794	0.70
Park and Market Station	21	18	5,618	6,106	8.69
E Street Bayfront Trolley Station	17	19	6,397	5,959	-6.85
Oceanside Transit Center	18	20	6,162	5,546	-10.00

Source: San Diego Association of Governments (SANDAG), "Fiscal Year 2006 Weekday System Ridership Profile," *Assistance to Transit Operations and Planning, Fiscal Year 2006*, available www.sandag.org/uploads/publicationid/publicationid_1272_6235.pdf, accessed November 28, 2007.

Other important bus/rail and bus/bus transfer stations include H Street Chula Vista, Iris Avenue, the El Cajon Transit Center, the SDSU (San Diego State University) Trolley Station, the Euclid Trolley Station, the Fashion Valley Trolley Station, the Escondido Transit Center, the Vista Transit Center, and the Oceanside Transit Center. Some of these stations, such as

Fashion Valley Trolley Station and SDSU, are important destinations in their own right, but in addition, transferring also takes place. Others are primarily locations of transfer movements. Most of them are rail/bus stations. Only the Vista and Escondido Transit Centers were bus only in 2006, but even these stations became bus/rail stations with the opening of the Sprinter diesel light rail service on March 9, 2008. The location of these stations is shown in Figure 139, which shows passenger boardings in 2005 only, before the Green Line opened. The strategic importance of the stations in connecting a collection of routes into a regional network is evident in the figure.

Figure 139 also reveals the importance of rail service in developing regional transit patronage. (This figure exhibits data collected before the eastern part of the Mission Valley light rail line opened.) The overwhelming majority of stations that stand out to the eye as the major points were transit patrons are boarding transit vehicles are light rail stations where there are large volumes of passengers transferring between modes. It also shows the paucity of patronage in the regional bus corridors. In general, the figure shows that the rail, but not the bus, part of the regional transit vision largely has borne fruit.

Emerging and Declining Ridership Markets

The study's interviewee observed that major transit corridors that have remained bus routes (as opposed to being developed as LRT) have not seen the patronage increases that LRT corridors have experienced.[230] He attributed this lack of patronage development to a combination of consumer preferences for rail service and policy decisions not to improve bus service quality or bus rider waiting environments in these corridors enough to encourage more ridership.

Today, the three light rail routes serving these corridors carry around 110,000 passengers per day, and patronage continues to grow at a brisk pace. Figure 140 shows the 12-month moving average of daily light rail patronage from 2003 to 2007. The trend is clearly upward. The corridors where light rail has not yet been built remain served by buses, but patronage languishes by comparison. In these corridors, the buses leave the freeway to make stops at important en-route destinations and transfer centers.

The highest patronage experienced by these freeway express routes is in the employment-rich I-15 corridor stretching north from the CBD to Escondido, shown as Route 20 in the Service Concept Element. Variations of Express Bus 20 serve this corridor throughout the day and on weekends, and they are supplemented by peak period service on Express Routes 810, 850, and 860. In total these routes board about 5,600 passengers per week day, according to figures obtained from SANDAG. This is comparable to the roughly 6,000 daily boardings for the Coaster commuter trains, running in the I-5 corridor, but considerably less than the roughly 20,000 to 50,000 passengers carried daily on each of the light rail lines.

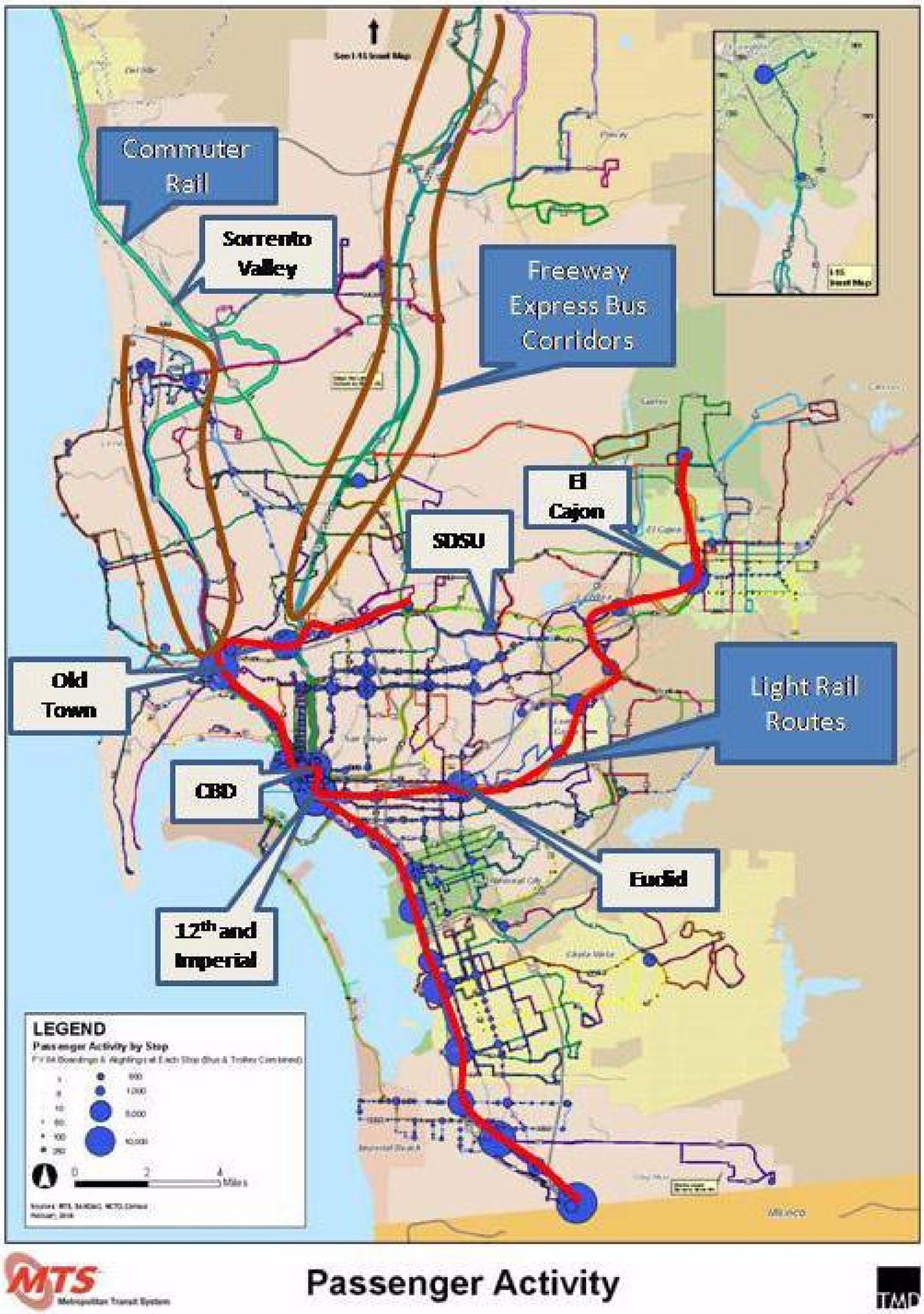


Figure 139 Boardings at transit stops within the San Diego region, 2005 (before opening of Green Line)

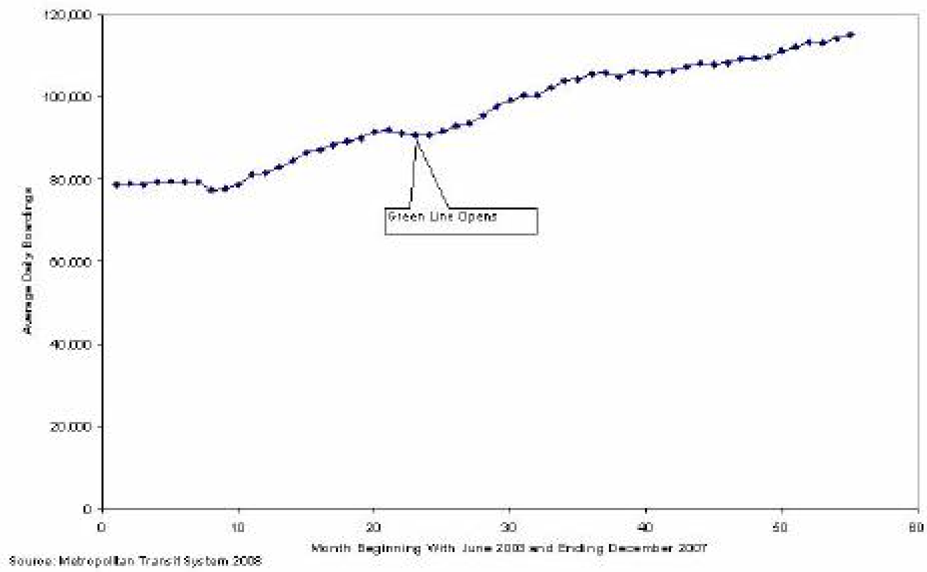


Figure 140 San Diego LRT 12-month moving average daily boardings

As a consequence of patronage decline on all modes following 2001, MTDB hired consultants to conduct a comprehensive operational analysis. The consultants concluded that the downward trend did not signify short term conditions, but rather a secular decline in demand for transit. The consultants speculated that the decline was a result of an increasing number of job-holders within the San Diego region living outside of the region far to the north in Riverside County. These persons could not possibly use transit to reach jobs in San Diego County. Some types of service seemed more susceptible to decline than others. The consultants noted that the greatest decline in patronage was on bus routes serving the CBD. The consultants noted that light rail patronage, after falling for a couple of years after 2001, actually was beginning to increase.[231]

At this point, it is unclear whether the decline is continuing. The authors have noted strong growth in light rail ridership over the past three years, and news accounts indicate that Coaster ridership and overall bus ridership are growing.[232] What is clear is that major corridors not served by light rail are seeing much less transit ridership growth than those corridors served by light rail. Because most of the heavy employment growth is in the bus corridors to the north, while most of the light rail development is in the mid to south county, there is a likelihood that overall regional transit growth will stagnate. This is in contrast to the Portland region, where the light rail line runs through the center of the most rapidly developing employment centers while also serving concentrations of lower income housing that could be supplying workers for the growing jobs.

Transit and Development

Earlier in the case study, the authors observed that San Diego has tried to tie land use development with transit planning. SANDAG has also been an active promoter of transit-oriented development (TOD), of which some are seen as successful. Transit has also played a role in revitalization efforts in the center city area of San Diego, despite the sentiment among some center city entities, including the Centre City Development Corporation (CCDC), that transit was not an asset.

The study's interviewee characterized the center city as having revitalized considerably, with the opening of Horton Plaza, then the Gaslamp Quarter, and finally the new ballpark as major stimuli. Most center city redevelopment has been residential, and efforts to attract more employment have lagged behind expectations, according to the study's contact, though as been shown earlier, CBD employment has grown substantially.

Public Attitude Toward Transit

The authors' contact pointed to a positive view of transit in the San Diego area, as evidenced by public support of efforts to extend the local option dedicated sales tax.[233] The interviewee stated transit's standing began to improve with the advent of LRT.

DISCUSSION

Starting in the mid-1970s, San Diego experienced a strong political tug-of-war over alternative visions of transit development. This struggle resolved in the direction of developing an integrated bus-LRT network that emphasized improved productivity at lowest possible cost and connecting transit to a larger number of destinations. Since advent of LRT in 1981, evolution of both transit system and its usage has validated this vision. San Diego has maintained strong and stable productivity while increasing riding habit substantially. San Diego has adapted its transit system to better fit its dispersed pattern of travel destinations. In many respects, San Diego is a model of how to successfully integrate bus and rail services.

But there are some areas of concern. There is a mismatch between the geographic areas of LRT investment and those of employment growth. San Diego pursued an express bus strategy in major employment corridors, such as I-5 and I-15. These services have not generated high ridership, although they serve corridors with large numbers of jobs and moderately dense residential developments. San Diego has also recently embarked on a bus rapid transit (BRT) strategy to try to serve some of this employment, but the proposed facilities will be very expensive, disruptive, and, in all likelihood, will not attract the hoped-for ridership. Finally, for budget reasons, San Diego changed its fare policy in January 2008 and no longer accepts free transfers. This change has potentially serious implications for a transit system that relies so heavily on transfer activity.

APPENDIX K
SAN JOSÉ, CALIFORNIA

SETTING

The San José Metropolitan Statistical Area (MSA) consists of two counties in central California: Santa Clara County and San Benito County.[234] However, for purposes of this investigation, the study focuses solely on Santa Clara County, which is located at the southern end of San Francisco Bay (see Figure 141).

Figure 141 San Francisco Bay Area counties

Santa Clara County occupies 1,291 square miles of land.[235] In 2005, Santa Clara County had a population of 1.7 million persons. The county's population density was approximately 1,300 persons per square mile. The primary city is San José, which is the San Francisco Bay Area's most populous city. Santa Clara County is the home to Silicon Valley, the nation's largest concentration of high-technology firms.

Distribution of MSA Population and Employment

Santa Clara County was once a prototypical suburban residential county. However, it has become a major employment center since the 1970s, as the high-technology center of Silicon Valley emerged. Both population and employment are dispersed within the county, although both are largely contained within its northern sections. Since 1970, both population and employment have grown steadily, except for the period of economic decline associated with the early 2000s high-technology bubble (see Table 146). Population increased nearly 60% between 1970 and 2005, from just over 1 million to approximately 1.7 million persons.

Figure 142 displays the distribution of population by transportation analysis zone (TAZ) for 2005, the most recent year for which these data are available. Population is mapped as the number of persons per acre. The boundary of Santa Clara County is outlined in red on the map. The map shows that population in the county is largely concentrated in the northern portions of the county nearest to the San Francisco Bay and the other bay area counties. Within this portion of the county, however, population is dispersed. There are a handful of clusters to the east of the San José CBD and in the western suburbs, but population density in much of this area is remarkably even.

Employment increased faster than population over this same period, due to the emergence of Silicon Valley (see Table 146). Total Santa Clara County employment increased more than 140% from 460,000 to 1.1 million jobs. Employment increased faster outside the San José central business district (CBD) (148%) than inside the San José CBD (96%). The San José CBD is a very modest-sized employment center, and is dwarfed by other employment centers in the county.

Figure 143 displays the distribution of employment by transportation analysis zone (TAZ) for 2005, the most recent year for which these data are available. Employment is mapped as the number of jobs per acre. The boundary of Santa Clara County is outlined in red, and the location of the CBD is labeled. The map shows that employment is dispersed within Santa Clara County, but it is more clustered than is population. There is a major cluster of employment to the northwest of the San José CBD and employment clusters extending in corridors that follow the area's major transportation arteries: a corridor along US 101 to the northwest, along US 880 to the north, and along the spine of US 880/SR 17 to the south. The major employment clusters near Stanford University are visible in the upper west corner of the county, and the major employment centers of the Silicon Valley suburbs are visible to the west of the San José CBD.

Table 146 Population and employment in the San José metropolitan area (1970–2005)

Year	Santa Clara County Population	Santa Clara County Employment		
		San José CBD	Outside CBD	Total
1970	1,065,313	31,000	426,616	457,616
1971	1,100,500	32,125	428,225	460,350
1972	1,138,800	33,291	458,757	492,048
1973	1,163,900	34,500	501,857	536,357
1974	1,164,600	35,752	531,747	567,499
1975	1,192,800	37,050	531,871	568,921
1976	1,206,700	38,395	568,456	606,851
1977	1,231,600	39,789	605,253	645,042
1978	1,260,400	41,233	656,103	697,336
1979	1,271,400	42,730	717,518	760,248
1980	1,295,071	44,300	760,862	805,162
1981	1,324,722	43,737	779,951	823,688
1982	1,345,039	43,182	796,629	839,811
1983	1,374,018	42,634	827,757	870,391
1984	1,396,226	42,092	886,095	928,187
1985	1,419,520	41,557	900,226	941,783
1986	1,429,933	41,030	897,942	938,972
1987	1,447,591	40,509	930,266	970,775
1988	1,472,234	39,994	975,255	1,015,249
1989	1,498,121	39,486	988,725	1,028,211
1990	1,498,307	39,000	1,005,672	1,044,672
1991	1,513,118	40,170	991,352	1,031,522
1992	1,531,886	41,375	967,662	1,009,037
1993	1,549,185	42,616	970,507	1,013,123
1994	1,561,366	43,895	982,280	1,026,175
1995	1,580,245	45,212	1,019,237	1,064,449
1996	1,608,695	46,568	1,072,372	1,118,940
1997	1,637,414	47,965	1,114,867	1,162,832
1998	1,658,960	49,404	1,155,713	1,205,117
1999	1,671,498	50,886	1,164,101	1,214,987
2000	1,682,585	52,400	1,230,271	1,282,671
2001	1,689,783	53,972	1,187,553	1,241,525
2002	1,674,727	55,591	1,087,790	1,143,381
2003	1,675,492	57,259	1,039,141	1,096,400
2004	1,681,980	58,977	1,032,384	1,091,361
2005	1,699,052	60,746	1,056,411	1,117,157

Source: U.S. Bureau of Economic Analysis 2007; U.S. Census Bureau 1970, 1980, 1990, 2000; U.S. Census Bureau 2007.

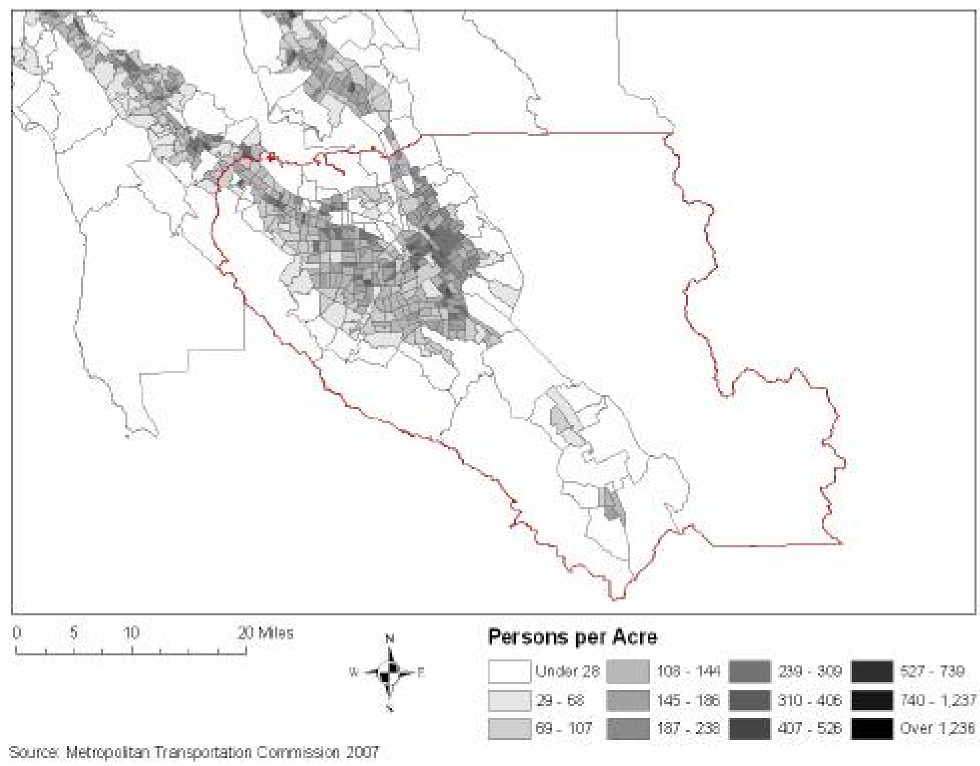


Figure 142 Santa Clara County: population density by transportation analysis zone (2005)

This discussion of population and employment indicates that Santa Clara County is a growing, decentralized county. However, neither population nor employment are scattered throughout the county. Both are largely located in the northern portion of the county nearest the San Francisco Bay. Within this portion of the county, population is dispersed, while employment tends to be more clustered. This urban structure has clear implications for the structure of a transit system. The pattern of employment in particular suggests a dispersed, multidestination transit structure that connects major employment clusters and corridors to one another. The authors discuss the transit system in Santa Clara County later in the case study.

Institutions and Key Actors

Transit planning and policy in Santa Clara County is affected by the decisions of two primary public entities: the transit agency (VTA) and the metropolitan planning organization (MTC).

Santa Clara Valley Transportation Authority (VTA)

The Santa Clara Valley Transportation Authority (VTA) is the primary transit agency in Santa Clara County. VTA operates light rail transit and bus services in the county. VTA is governed by a 17-member appointed board of directors that includes elected officials representing the member jurisdictions. Twelve of these 17 members are voting members, while five are alternates. The board also has a non-voting ex-officio member who is one of the county's representatives on the MTC board.

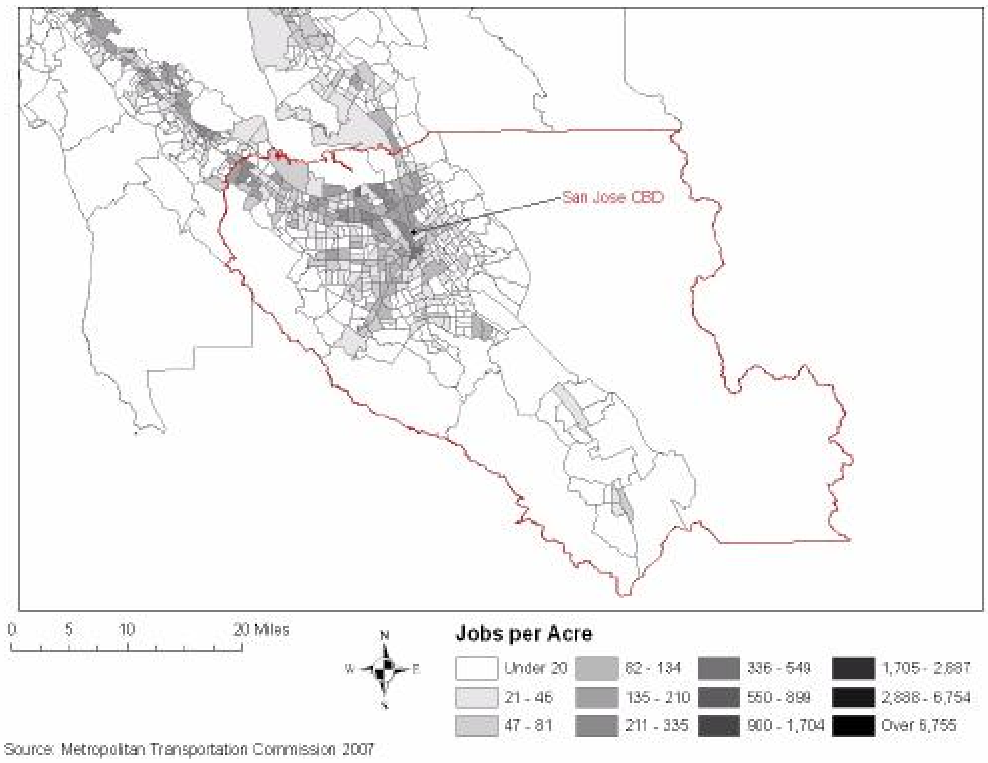


Figure 143 Santa Clara County: employment density by transportation analysis zone (2005)

Metropolitan Transportation Commission (MTC)

The Metropolitan Transportation Commission (MTC) is the regional transportation planning agency and metropolitan planning organization (MPO) for the nine-county San Francisco Bay Area region. As the San Francisco Bay Area's MPO, MTC is responsible for approving the short-term Transportation Improvement Program (TIP) and Long Range Transportation Plan (LRTP) required for federal aid projects. MTC is governed by a 19-member policy board that includes 14 members appointed from the nine member counties, one member each from the Association of Bay Area Governments and the Bay Conservation and Development Commission, and three non-voting members representing U.S. Department of Housing and Urban Development, U.S. Department of Transportation, and California Department of Transportation.

Transit Agencies, Modes, Fares, and Rider Profiles

The transit picture in Santa Clara County is very complicated. A number of transit agencies provide service that crosses into Santa Clara County, including Caltrain commuter rail service, ACE (Altamont Commuter Express) commuter rail service, Samtrans (San Mateo County Transit District) bus service, and AC Transit (Alameda-Contra Costa Transit District) bus service. BART (Bay Area Rapid Transit District) is in the process of extending its heavy rail transit service into the county. In addition to all of these agencies that also provide service outside the county, the Santa Clara Valley Transportation Authority (VTA) operates bus and light rail transit service inside the county. Because it is difficult to apportion ridership and service by geographic area for the various agencies that provide most of their service and attract most of their ridership outside Santa Clara County, the authors have elected to focus this study's analysis on VTA, as the primary transit agency within the county.

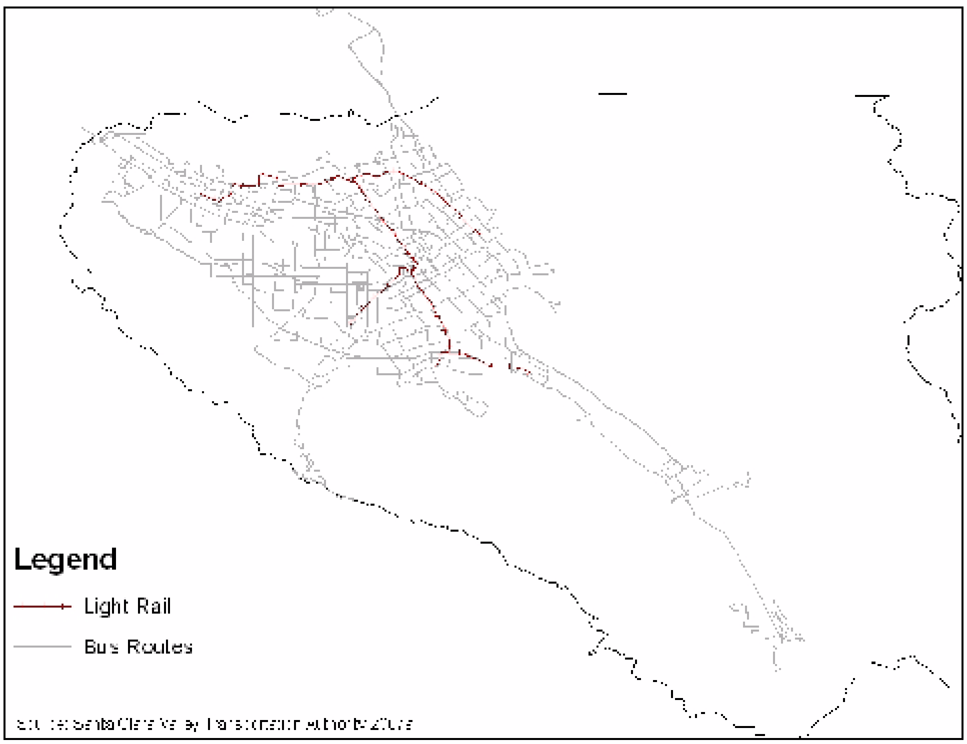


Figure 144 Santa Clara Valley Transportation Authority (VTA) transit system (2007)

VTA operates both bus and light rail transit service inside Santa Clara County (see Figure 144). Most service is located in the northern portions of the county, where the bulk of population and employment are located. VTA operates 74 fixed-route bus lines, of which 24 lines serve the San Jose CBD. VTA operates three light rail lines, one of which is a spur line (see Figure 145). The first segment of the LRT system opened in 1987, and the most recent segment in 2005 (see Table 147). The LRT system now totals more than 40 miles.

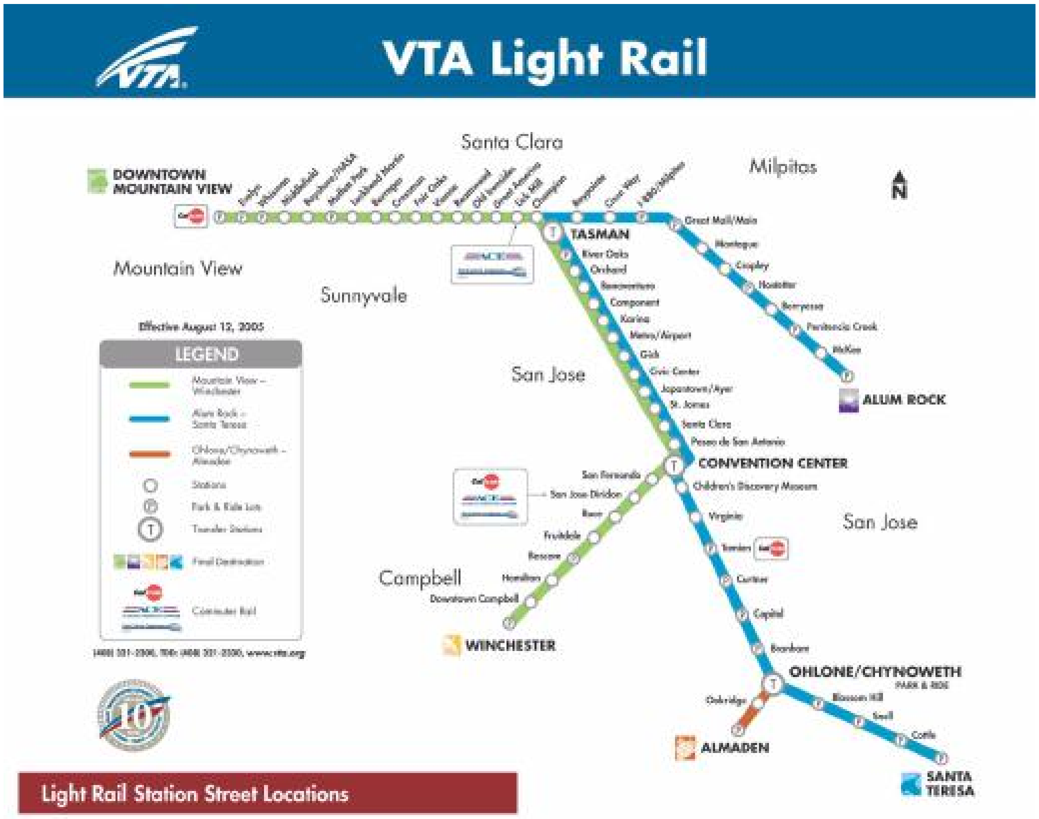


Figure 145 Santa Clara Valley Transportation Authority (VTA) light rail system

VTA fares vary depending on the type of service used.[236] LRT, regular bus, and limited stop bus adult one-way fares are $1.75. Community bus adult one-way fare is $1.00. Express bus adult one-way fare is $3.50. Senior citizens, youths, the disabled, and individuals on Medicare are eligible for reduced fares. Individuals paying one-way ride fares are not eligible for free transfers. VTA also sells day and monthly passes that permit unlimited rides. Caltrain passengers with monthly tickets with two different zones punched may ride all VTA Regular and Limited Stop Buses and Light Rail services free of charge.

VTA commissioned an on-board survey in 2005–2006 that allowed the authors to develop a profile of transit users. Table 148 presents the rider profile. The table shows that VTA riders are largely a transit-dependent group. More than 80% of riders have limited or no automobile availability. More than half of riders have household incomes under $25,000. Seventy percent of riders are members of minority groups.

Table 147 San José light rail transit segment openings

Year	Segment Length (miles)	Line	Section	Cumulative System Length (miles)
1987	2.2	Tasman West Light Rail	Old Ironsides–Tasman	2.2
1987	4.4	Guadalupe Light Rail	Tasman–Younger Street	6.6
1988	2.1	Guadalupe Light Rail	Civic Center–Convention Center	8.7
1990	1.6	Guadalupe Light Rail	Convention Center–Tamien	10.3
1991	8.6	Guadalupe Light Rail	Tamien–Santa Teresa	18.9
1991	1.2	Almaden Light Rail	Ohlone/Chynoweth–Almaden	20.1
1999	0.3	Tasman West Light Rail	Baypointe–Tasman	20.4
1999	7.6	Tasman West Light Rail	Old Ironsides–Mountain View	28.0
2001	1.9	Tasman East Light Rail	Baypointe–I-880/Milpitas	29.9
2004	2.9	Tasman East Light Rail	I-880/Milpitas–Hostetter	32.8
2004	3.5	Capitol Light Rail	Hostetter–Alum Rock	36.3
2005	1.0	Vasona Light Rail	Children's Discovery Museum–San José Diridon	37.3
2005	4.3	Vasona Light Rail	San José Diridon–Winchester	41.6

Source: Leroy Demery, *U.S. Urban Rail Transit Lines Opened from 1980*, October 18, 2005, 27–28.

Table 148 Demographics of VTA Riders

Survey Category	Response	Total Percent
Ethnicity	Hispanic	37
	White	28
	Asian	20
	African American	10
	Pacific Islander	3
	Native American	2
Gender	Male	54
	Female	46
Age	13–17	13
	18–24	22
	25–34	24
	35–44	16
	45–64	21
	65 and over	5

Source: NuStats Partners, *Santa Clara Valley Transportation Authority, 2005–2006 On-Board Passenger Survey*, Final Report, October 2006, 22–23, 26–27.

Table 148 Demographics of VTA Riders

Survey Category	Response	Total Percent
Income	Under $10,000	33
	$10,000–$24,999	23
	$25,000–$49,999	19
	$50,000–$74,999	11
	$75,000–$99,999	7
	$100,000–$149,999	4
	$150,000–$199,999	1
	Over $200,000	2
Auto dependency	Auto available	19
	Limited auto availability	16
	No automobile	65

Source: NuStats Partners, *Santa Clara Valley Transportation Authority 2005–2006 On-Board Passenger Survey, Final Report*, October 2006, 22–23, 26–27.

Transfers

The same on-board survey contains data about transfer rates for VTA bus and rail patrons. This information is contained in Table 149, which reports access and egress modes for LRT and bus riders. To obtain the transfer rate for each mode, the authors sum the percent accessing that mode via a transfer from bus, LRT, or Caltrain and add this sum to the total percent that egress from that mode via a transfer to bus, LRT, or Caltrain. The result yields a bus transfer rate of 37.3% and an LRT transfer rate of 39.6%.

Table 149 Access and egress modes for VTA riders

Response	Access		Egress	
	Bus Percent	Light Rail Percent	Bus Percent	Light Rail Percent
Walked	73.1	61.7	74.4	68.3
Mobility device for people with disabilities	0.5	0.4	0.5	0.4
Drove	2.1	9.7	1.1	6.7
Transferred from LRT	5.0	8.4	4.1	4.8
Transferred from bus	12.5	11.7	13.6	11.9
Transferred from Caltrain	1.2	1.5	0.9	1.3
Dropped off by automobile	2.6	2.2	2.0	2.0
Bicycle	2.9	4.5	2.7	4.4
Other	0.0	0.0	0.5	0.4

Source: NuStats Partners, *Santa Clara Valley Transportation Authority 2005–2006 On-Board Passenger Survey, Final Report*, October 2006, 54.

ANALYSIS

Regional Transit Vision and Its Evolution

The study's interviewees provided detailed accounts of the planning processes that led to the implementation of light rail transit (LRT) in Santa Clara County.[237] Their involvement with transit planning in Santa Clara County dates back to the early 1970s; this was prior to public takeover of the then-private systems. One interviewee, Mr. Diridon, played an important role as a political champion of transit development in the county, while the other interviewee, Mr. Minister, worked inside the public transit agency itself.

At the time of Mr. Diridon's election to the Saratoga city council in 1971, there was no public transit agency in Santa Clara County, just bankrupt local private transit systems and the Southern Pacific commuter rail line (now Caltrain) carrying 12,000 daily riders. Mr. Diridon characterized the city of San Jose and Santa Clara County public works departments as being very auto-oriented. The key event that changed these conditions was enactment of California's Transportation Development Act (TDA) in 1972, which levied a ¼ cent sales tax to support public transit agencies. Shortly thereafter, a public transit agency was created in Santa Clara County. The county then acquired the local transit systems and their run-down bus fleets.

These events led to a series of transit master plans, the first of which was carried out under leadership of County Public Works Director James Pott. Mr. Pott's master plan resulted in the creation of a dial-a-ride system for the general public spread over 400 urbanized square miles of territory. Pott acquired 135 twin coaches (25 passenger coaches) for the dial-a-ride service, which the county transit agency operated. Dial-a-Ride service became operational in January 1973, was immediately overwhelmed with calls, but nevertheless attracted very low ridership.

The poor ridership results concerned members of the board of supervisors, whose members included Mr. Diridon in 1974. Mr. Diridon took the transportation portfolio on the board. Mr. Diridon convinced the Board of Supervisors to commission an emergency study of dial-a-ride that concluded that Dial-a-Ride could not be successful with the available fiscal resources and given the area's land use pattern. Mr. Diridon proposed eliminating dial-a-ride service and converting the transit system into a fixed-route system. Mr. Diridon recalled that consultants used old route maps and did some additional work in laying out the fixed-route system. The new bus system went into operation in August 1974. During its first month, ridership was low (20,000-30,000 rides) but ridership steadily increased.

Santa Clara County put much of its remaining TDA funding into reserves, for potential development of a rapid transit system. The county had launched a transit visioning study, called Rapid Transit Development Project Phase 1, in 1973. Mr. Diridon served on the study board. The study's charge was to identify the county's long-term transit needs. In 1974, a study of the Southern Pacific commuter rail service also got underway, with Mr. Diridon as chair of the study board. The study's second interviewee emphasized that Mr. Diridon became the major political champion of transit development in the county, including the eventual development of LRT. He stressed Mr. Diridon's formidable skills at coalition building with diverse groups ranging from the American Lung Association and clean air advocates to Greenbelt proponents to members of the Modern Transit Society as particularly important assets he brought to the planning and policymaking tables.[238]

In mid-1976, the Phase 1 visioning study reported results. The study noted the dramatic growth in the region, due to Silicon Valley's emergence, and the inadequacy of the existing transportation system. The study report called for development of a new highway system, new bus system, and a new medium-capacity rapid transit system. The recommended highway investments included expanded arterials, deployment of signal synchronization technology, and the completion of the county's freeway master plan. The county had many unbuilt freeways, including some for which the public already owned the necessary right of way.

The recommended medium-capacity rapid transit system eventually morphed into light rail transit (LRT). One of the interviewees pointed to the successful efforts in Germany to rebuild its streetcars, and the first LRT conference as key events in this evolution.[239] The other interviewee pointed to developments in San Diego as a model that San José officials were observing with keen interest.[240]

The proposed LRT system was 140 miles and was designed to work with an expanded bus system to connect residential locations and the major activity centers in the county. The entire system would follow a grid pattern with focal points on the CBD, South San José, and the northern corridor of employment centers. Buses would feed the LRT line. The LRT alignments would be located inside or adjacent to freeways. Concept LRT lines were identified, but listed in no priority order. One of the interviewees stressed the roles played by local newspapers and advocacy groups like Modern Transit Society in building a groundswell of public support for the plan.[241]

At Mr. Diridon's urging, the Santa Clara County Board of Supervisors placed a ½ cent transit sales tax on a March 1977 special election ballot. Proponents ran a campaign appealing to environmentalists and transit riders to vote for the tax. They were supported by interest groups including the Santa Clara Valley Manufacturing Group (now Silicon Valley Leadership Group), League of Women Voters, Sierra Club, and Modern Transit Society. Opponents included highway interests and the chamber of commerce. In a low-turnout election (17%), the sales tax measure passed with 56% support, becoming the first dedicated transit sales tax in California.

Among three corridors evaluated on the basis of two criteria (most riders at lowest cost and most perishable land), Guadalupe ranked first, Tasman ranked second, and Vasona ranked third. Vasona had been Diridon's desired corridor. After holding public hearings, the Board of Supervisors selected the Guadalupe Corridor and preliminary engineering began on this priority corridor.

One of the study's interviewees noted that LRT advocates then joined forces with freeway advocates to build a joint LRT-highway facility in the Guadalupe Corridor.[242] This contact said both sides would have lost if they had not allied. The alliance led to an alternatives analysis for federal aid that was completed by 1981. This contact emphasized the support of Governor Jerry Brown and Caltrans Director Adrianna Gianturco, both of whom championed a more multimodal approach to transportation at the state level. With state support now assured, the decision was made to build a 21-mile starter line from South San José through CBD to Santa Clara.

By the time San José officials approached the federal government for capital assistance, Ronald Reagan had been elected president and he refused to permit grants to transit. The local congressional delegation forged an alliance with the congressional delegation from Miami to create an earmark to fund both the Miami Metro Rail and San José LRT projects. This effort succeeded. By 1985, the line was under construction, and so was a transit mall in downtown San José. The first line opened in 1987.

The decision to build LRT in the same corridor as a freeway has posed serious challenges to LRT, particularly as the nature of the freeway facility evolved. Right of way had been set aside for state highway 87 parallel to the Guadalupe River. Engineers had cautioned that LRT would be successful if no competing highways existed, and the county Board of Supervisors voted to develop the corridor as LRT with no freeway.

One of the interviewees noted that during the engineering phase, Caltrans demanded retention of right of way for freeway development.[243] Local officials agreed with this demand because they doubted the state would ever come up with money for freeway development. However, they eventually did. A political compromise led to agreement to develop only a two-lane maximum (in each direction) super expressway, and the LRT and super expressway were built at same time. Once the new highway facility opened, it became congested, the public complained, and Caltrans responded by adding an additional lane in each direction.

The highway has since become both a serious modal competitor and hinders passenger access to the LRT, particularly for those passengers trying to reach or leave the light rail line by bus. Mr. Diridon now says he would advise those planning LRT lines not to build in a freeway right of way. The bus-rail interface is awkward. Buses stop at parking lots, and not on the overpasses. This means that buses must lose precious minutes as they turn off the arterial roads at congested intersections and then thread their way around circuitous one-way loops within the lots. Once they finally reach their stopping place, they still are far removed from the rail platforms. Bus passengers alight, then walk across parking lots, climb up long flights of stairs to reach a pedestrian crossing that spans the freeway, cross to the middle of the freeway over the din of hundreds of cars and trucks speeding underneath at 60 to 70 mph, and then climb down other long flights of stairs to access the LRT, wedged onto an island amidst the roaring traffic. The difficulty and unpleasantness of accessing the LRT in such a repellent setting, combined with the modal competition provided by the presence of the freeway, may partially explain lower than expected LRT ridership.

Another difficulty is posed by slow LRT speeds in downtown San José. The State of California's Public Utilities Commission (PUC) permits only a 10 mph maximum speed on the Transit Mall unless safety-related infrastructure is provided. In its planning of the light rail system, the VTA assumed a maximum running speed of 25 mph along the transit mall, but when it came time to open the system, it was rebuffed by the PUC. The PUC found that railings separating pedestrians and trains were insufficient provisions for pedestrian safety and required instead that the grades of pedestrian walkways and light rail trains be separated by three or four inches, much as a roadway is lower than a sidewalk. Adding this seemingly minor feature would have required reconstruction of the mall, and according to one of the study's interviewees, the City of San José has opposed the design changes and reconstruction necessary to get approval for a 25 mph LRT speed.[244] So, the light rail line has to live with the very slow speed through the downtown, which requires trains to consume 12 minutes on the Guadalupe Line and 17 minutes on the Vasona Line to negotiate. Unfortunately, most light rail passengers neither board nor alight light rail trains in the downtown and want to travel through downtown and to their destinations much faster than the 10 mph speed allows. The study's contact characterized the LRT's non-competitive (with the automobile) speed as a fatal flaw.[245]

Still an additional factor contributing to lower than planned ridership is the bus system itself. There are two problems here. First, it is laid out according to a grid principle, but the midday headways of many routes are both long and irregular. Long and irregular headways make the task for bus passengers of transferring between bus routes onerous. Passengers transferring between buses and trains and from trains to buses also face unpredictable and often lengthy waits, adding to both anxiety and inconvenience.

Second, buses do not connect sizable parts of the residential districts of Santa Clara County with the light rail line spine, which, if they did so, could function as a distributor to a large number of jobs. It is as though the ribs have been broken off the spine and lie more or less parallel to it. This quality is particularly pronounced for the populous west side of the valley, north of the CBD. Just to the east of this area runs the north-south Guadalupe Corridor light rail line with stations at major employers. It would be a natural for east-west buses to run through the populous areas west of the Guadalupe Corridor before intersecting with it. If they did, bus passengers could change to trains to access jobs both north and south. By and large, such connections are missing.

The study's interviewees had a mixed assessment of the LRT's ridership performance once the system opened. One contact stated that forecasts had predicted 40,000 riders per day for 1990, but actual ridership was perhaps 16,000 and eventually reached 20,000 per day.[246] This contact blamed the problems noted above plus low CBD employment, the expansion of numerous highways, and the dispersed land use patterns for the lower-than-expected ridership. He noted that the planned integration of light rail with buses was not handled well. One contact observed that VTA uses a timed-transfer system, but that financial difficulties mean its efficiency has deteriorated. At the north end of line, VTA tried to get private shuttles in place to serve jobs that tend to be located in campus-style developments located away from the rail stations, but these services did not materialize for a while.

The other contact said the forecast called for 12,000 riders per day but reached 17,000 per day, and that LRT exceeded ridership estimates up to the high technology bubble and recession of the early 2000s.[247] At that time, ridership plummeted and so did revenue, although this contact reports that ridership has rebounded since the economy recovered.

The economic downturn also affected sales tax revenues used to fund major capital investments, like the BART extension and new LRT lines. According to one of the interviewees, the economic downturn reduced sales tax revenues by half.[248] The revenues are back up to projections, but the anticipated revenues lost in intervening years are gone, which has led to serious financial difficulties in agency. There is a proposal for a ¼ cent sales tax to recover the lost money that may appear on ballot in June 2008 or November 2008.

Nevertheless, there are numerous projects under way. The BART extension to San José is in final engineering, although they lack $800 million of the $4 billion needed to complete it. MTC recently approved high-speed rail through San José via Pacheco Pass. They will quadruple track the Caltrain alignment from Gilroy to San Francisco. Diridon station will become a major transfer point for bus, LRT, Caltrain, ACE, and high-speed rail services.

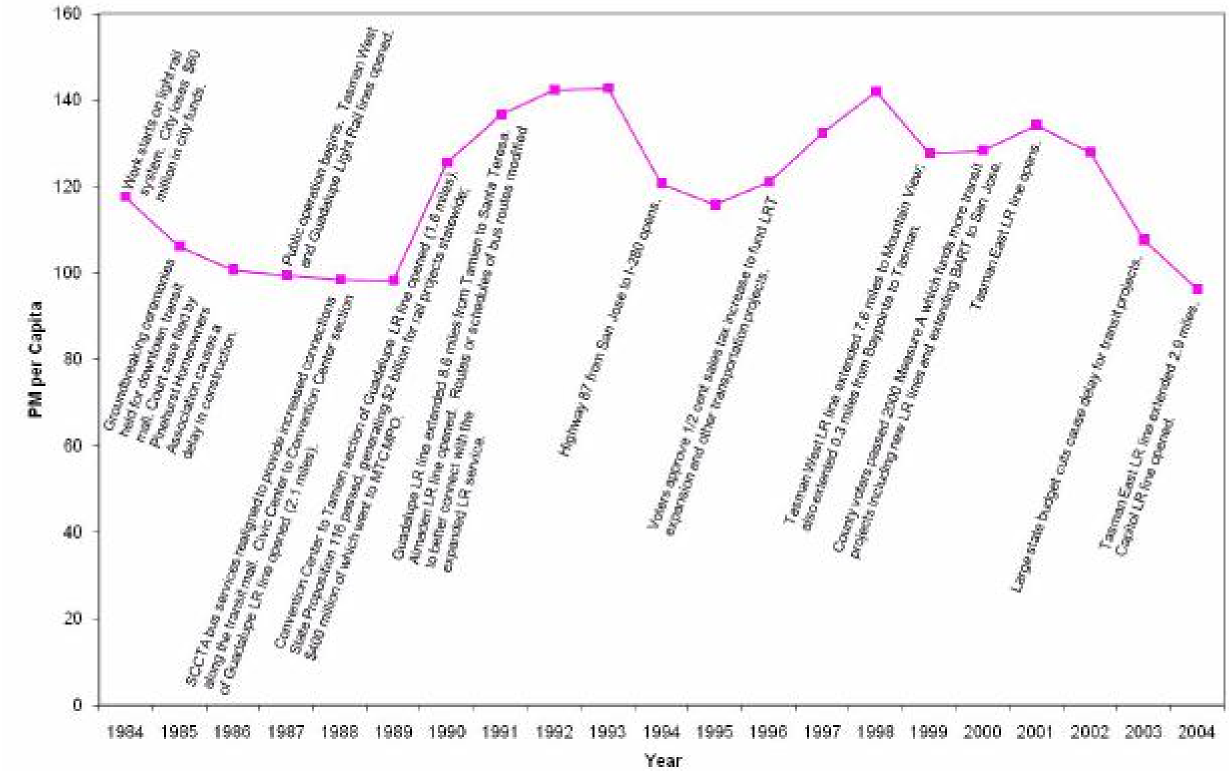
The high-speed rail plan requires a state vote for November 2008. The vote would permit the issuance of $9.95 billion in general obligation bonds, which covers 1/3 of the cost for a San Francisco to Anaheim via Palmdale alignment. The study's contact noted that high speed rail has the support of both the legislature and the governor.[249] He noted that high-speed rail may address local affordable housing issues by making commuting from the Central Valley into Silicon Valley more feasible.

Transit Ridership and Productivity

Regional Riding Habit and Service Productivity Trends

The authors examined trends in both transit riding habit (measured as passenger miles per capita) and service productivity (measured as passenger miles per vehicle mile, or load factor) for the period 1984 to 2004. Figure 146 displays riding habit. The measure of riding habit only takes into account ridership on VTA transit services. Overlaid on the graph are key service-related events that might also contribute to change in riding habit. Between 1984 and 2004, riding habit declined 18%. However, riding habit has been very cyclical, with cycles corresponding roughly with overall regional economic conditions, as well as with LRT extensions and bus service changes. Riding habit experienced peaks in the early 1990s and late 1990s and troughs in the mid-1990s and in the several years at the end of the graph. This most recent period corresponds to the economic downturn that affected the high-technology sector.

Figure 147 maps service productivity over the same period. Between 1984 and 2004, service productivity declined 3%. However, service productivity has also been cyclical, and has tended to track the changes in riding habit. Thus, service productivity has been influenced by economic conditions, LRT extensions, and bus service changes. Service productivity peaked in 1998, and has since declined 22%.



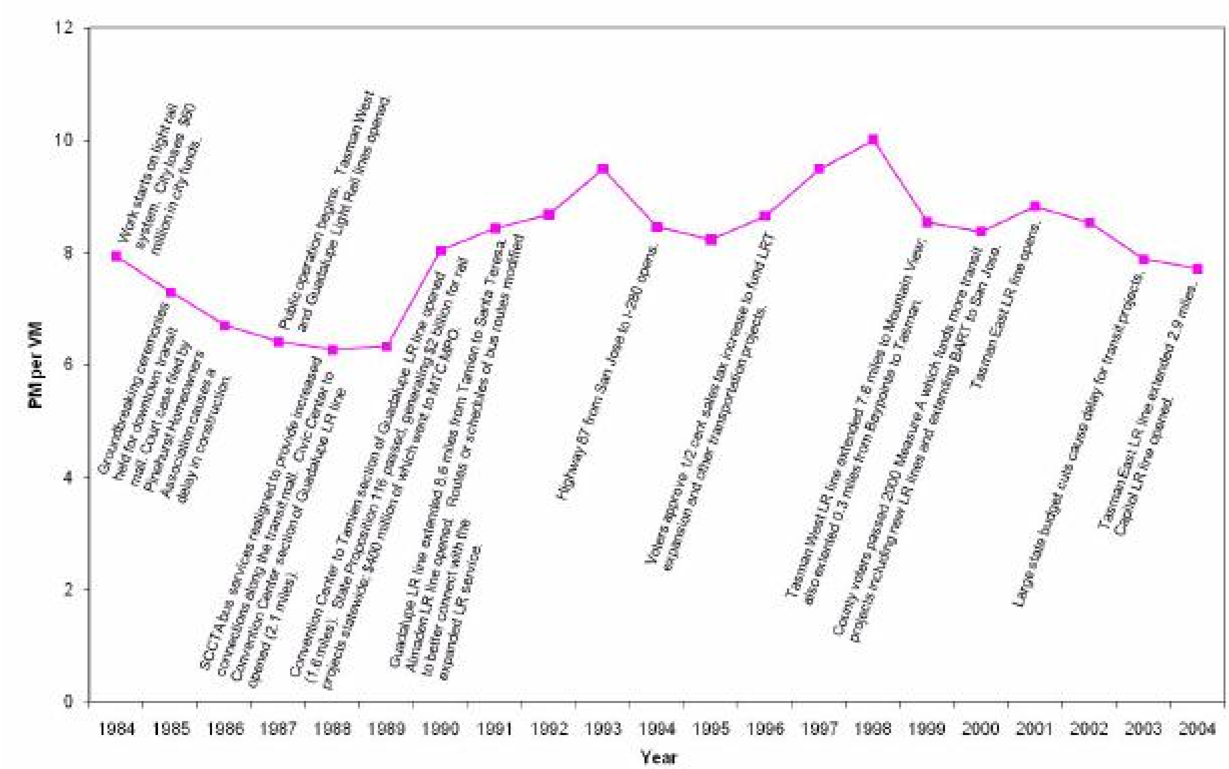
Source: U.S. Census Bureau 2006, Florida Department of Transportation 2006

Figure 146 San José MSA riding habit (passenger miles per capita) (1984–2004)

System Ridership and Productivity Trends

The authors examined ridership and service by both VTA bus and light rail transit service between 1984 and 2004. Table 150 reports ridership, measured both as passenger miles and (unlinked) passenger trips. The table shows that bus ridership declined between 1984 and 2004. The decline for passenger miles was steeper (16%) than the decline for passenger trips (13%), meaning that average trip lengths have declined slightly over this period. Table 151 reports that average bus trip lengths are indeed slightly shorter in 2004 than they were in 1984. Bus ridership peaked in both 1991 and in 1998 but declined in subsequent periods.

Table 150 also reports light rail ridership between 1988 and 2004. Light rail ridership increased significantly between those two dates, largely as a function of the system's extension. The table also notes that light rail ridership declined severely after 2001, as a function of the economic downturn in the high-technology sector. The average light rail trip length declined slightly over this recent period (see Table 151).



Source: Florida Department of Transportation 2006

Figure 147 San José MSA load factor (passenger miles per vehicle mile) (1984–2004)

Table 150 Ridership on VTA fixed-route transit services (1984–2004)

Year	Passenger Miles			Passenger Trips		
	Bus	Light Rail	Total	Bus	Light Rail	Total
1984	164,251,600		164,251,600	38,521,548		38,521,548
1985	150,655,216		150,655,216	34,609,336		34,609,336
1986	144,162,911		144,162,911	38,089,251		38,089,251
1987	143,932,224		143,932,224	36,299,004		36,299,004
1988	144,065,517	868,613	144,934,130	35,699,201	195,541	35,894,742
1989	140,540,598	6,611,504	147,152,102	36,442,503	2,007,748	38,450,251
1990	180,635,719	7,526,763	188,162,482	43,290,284	2,432,298	45,722,582
1991	191,953,345	14,691,957	206,645,302	46,101,615	3,981,245	50,082,860
1992	173,840,361	44,154,423	217,994,784	43,178,989	6,134,759	49,313,748
1993	178,450,233	42,620,372	221,070,605	45,671,972	6,245,385	51,917,357
1994	159,079,397	29,501,105	188,580,502	38,876,939	6,133,003	45,009,942
1995	156,552,771	26,413,114	182,965,885	39,387,474	5,659,319	45,046,793
1996	166,362,472	28,428,099	194,790,571	42,842,711	6,168,085	49,010,796
1997	185,830,660	31,036,590	216,867,250	46,180,701	6,728,392	52,909,093
1998	202,438,421	32,993,487	235,431,908	46,456,801	6,910,100	53,366,901

Table 150 Ridership on VTA fixed-route transit services (1984–2004)

Year	Passenger Miles			Passenger Trips		
	Bus	Light Rail	Total	Bus	Light Rail	Total
1999	180,822,464	32,819,898	213,642,362	47,986,418	6,862,705	54,849,123
2000	180,301,160	35,757,928	216,059,088	47,654,687	7,913,730	55,568,417
2001	184,306,724	42,461,895	226,768,619	48,063,338	9,237,074	57,300,412
2002	179,723,627	34,656,167	214,379,794	45,621,606	7,789,570	53,411,176
2003	153,530,704	26,815,297	180,346,001	39,774,627	6,052,519	45,827,146
2004	137,777,321	24,165,923	161,943,244	33,372,086	5,473,024	38,845,110

Source: Florida Department of Transportation 2006.

Table 151 Average trip lengths (VTA) (1984–2004)

Year	Average Trip Length (miles)		
	Bus	Light Rail	Total
1984	4.26		4.26
1985	4.35		4.35
1986	3.78		3.78
1987	3.97		3.97
1988	4.04	4.44	4.04
1989	3.86	3.29	3.83
1990	4.17	3.09	4.12
1991	4.16	3.69	4.13
1992	4.03	7.20	4.42
1993	3.91	6.82	4.26
1994	4.09	4.81	4.19
1995	3.97	4.67	4.06
1996	3.88	4.61	3.97
1997	4.02	4.61	4.10
1998	4.36	4.77	4.41
1999	3.77	4.78	3.90
2000	3.78	4.52	3.89
2001	3.83	4.60	3.96
2002	3.94	4.45	4.01
2003	3.86	4.43	3.94
2004	4.13	4.42	4.17

Source: Florida Department of Transportation 2006.

The authors noted that the amount of transit service VTA provides increased less than 2% between 1984 and 2004 (see Table 152). Bus service declined by more than 5%, and light rail service additions barely exceeded the reduction in bus service. Service on both modes is lower in 2004 than it was in 2000–2001, largely due to fiscal crises related to the economic downturn. VTA is very dependent on sales tax revenues, and these revenues dropped considerably during the recession.

Overall ridership increases barely exceed the overall increase in service provided; the result is that service productivity fell slightly between 1984 and 2004 (see Table 153). Bus and light rail service productivity have fallen from their peaks in the late 1990s.

Table 152 VTA fixed-route transit service (1984–2004)

Year	Vehicle Miles		
	Bus	Light Rail	Total
1984	20,709,523		20,709,523
1985	20,672,265		20,672,265
1986	21,528,238		21,528,238
1987	22,491,989		22,491,989
1988	22,900,245	233,890	23,134,135
1989	22,742,640	537,761	23,280,401
1990	22,862,841	556,740	23,419,581
1991	23,430,287	1,087,590	24,517,877
1992	23,028,963	2,109,746	25,138,709
1993	21,551,674	1,750,462	23,302,136
1994	20,554,546	1,754,721	22,309,267
1995	20,547,048	1,697,059	22,244,107
1996	20,616,117	1,898,131	22,514,248
1997	20,922,314	1,937,833	22,860,147
1998	21,423,253	2,125,920	23,549,173
1999	22,775,795	2,248,965	25,024,760
2000	23,332,077	2,483,317	25,815,394
2001	22,833,750	2,884,871	25,718,621
2002	22,580,693	2,554,932	25,135,625
2003	20,963,152	1,924,864	22,888,016
2004	19,001,893	2,017,835	21,019,728

Source: Florida Department of Transportation 2006.

Table 153 VTA service productivity (1984–2004)

Year	Bus	Light Rail	Total
1984	7.93		7.93
1985	7.29		7.29
1986	6.70		6.70
1987	6.40		6.40
1988	6.29	3.71	6.26
1989	6.18	12.29	6.32
1990	7.90	13.52	8.03
1991	8.19	13.51	8.43
1992	7.55	20.93	8.67
1993	8.28	24.35	9.49
1994	7.74	16.81	8.45
1995	7.62	15.56	8.23

Table 153 VTA service productivity (1984–2004)

Year	Bus	Light Rail	Total
1996	8.07	14.98	8.65
1997	8.88	16.02	9.49
1998	9.45	15.52	10.00
1999	7.94	14.59	8.54
2000	7.73	14.40	8.37
2001	8.07	14.72	8.82
2002	7.96	13.56	8.53
2003	7.32	13.93	7.88
2004	7.25	11.98	7.70

Source: Florida Department of Transportation 2006.

Bus Route Performance Analysis

The authors examined the performance of individual VTA bus routes to better understand which kinds of services are strong versus weak performers. They obtained route-based data on unlinked passenger trips, revenue hours, and revenue miles for the average weekday, Saturday, and Sunday. Using these data, they constructed two measures of route performance: (unlinked passenger) trips per revenue hour and (unlinked passenger) trips per revenue mile. The authors then divided the routes into groups based on the class of route, as defined by VTA, and whether or not the route serves the San José CBD. Table 154 reports the performance of the median route in each route group on both performance measures.

Table 154 VTA bus route performance

Route Type	Routes	Trips per Revenue Hour (median)			Trips per Revenue Mile (median)		
		Weekdays	Saturday	Sunday	Weekdays	Saturday	Sunday
All bus routes	74	16.95	19.22	18.60	1.32	1.47	1.50
All bus routes serving CBD	24	21.7	23.35	21.04	1.71	1.75	1.67
All bus routes not serving CBD	50	16.52	17.04	18.54	1.28	1.24	1.48
All local bus routes	55	20.95	19.22	18.72	1.62	1.48	1.52
All local bus routes serving CBD	15	24.75	23.75	21.89	2.03	1.83	1.72
All local bus routes not serving CBD	40	19.07	17.04	18.54	1.47	1.24	1.48
All express bus routes	10	9.55	19.10	15.69	0.37	0.84	0.69
All express bus routes serving CBD	5	12.09	19.10	15.69	0.48	0.84	0.69
All express bus routes not serving CBD	5	8.40	n.a.	n.a.	0.34	n.a.	n.a.
All limited-stop routes	5	9.32	n.a.	n.a.	0.42	n.a.	n.a.
All rapid service routes	1	27.42	19.49	n.a.	1.85	1.25	n.a.
All shuttle routes	3	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Sources: VTA 2007d, VTA 2007e

The table shows that most VTA bus routes (50 out of 74) do not serve the San José CBD, and that the CBD-serving routes (24 out of 74 routes) outperform their non-CBD-serving counterparts (see Table 154). VTA operates one rapid service, or BRT, route, and this is a very strong performer. Among the three basic route types (local, limited, and express), local bus routes are by far the strongest performers. One of the study's interviewees observed that VTA operates many unproductive routes, and would benefit from more efficient operations. Indeed, fourteen routes average fewer than 10 boardings per weekday revenue hour. Twelve of these routes do not serve the San José CBD.

Rail Performance Analysis

The same report used to generate the bus route performance statistics contains the performance statistics for two VTA light rail transit lines. The authors report the performance statistics for both lines in Table 155. The table indicates that the Santa Teresa-Alum Rock line is a much stronger performer than the Mountain View-Winchester line. The Santa Teresa-Alum Rock line is the eastern portion of the LRT system, while the Mountain View-Winchester line is the western portion of the system.

Table 155 VTA light rail transit line performance

Line	Trips per Revenue Hour			Trips Per Revenue Mile		
	Weekday	Saturday	Sunday	Weekday	Saturday	Sunday
Santa Teresa–Alum Rock	93.61	68.51	61.87	5.65	4.13	3.73
Mountain View–Winchester	65.33	61.63	47.72	4.52	4.17	3.23

Sources: VTA 2007d, VTA 2007e.

Figure 148 plots average weekday LRT boardings by station for 2007. The map indicates that the LRT system is not attracting a great deal of potential ridership. The total amount of boarding activity is much smaller than in the other study cities. The trunk line between Tasman and the Convention center has modest ridership activity at the stations, but there is very low ridership along most of the other segments. The relative scarcity of riders on the line extending west to Mountain View is particularly striking, given that this line lies near the heart of Silicon Valley, and that it is the site of well-publicized transit-oriented development. Its apparent circuitousness, superfluous number of closely-spaced stations, and consequent slow speed may depress patronage.

Emerging and Declining Ridership Markets

The study's interviewees noted that Silicon Valley is the primary travel destination for VTA riders, and not the San José CBD.[250] The dispersed pattern of destinations in much of Silicon Valley poses some connectivity problems for VTA. The San José CBD is a secondary travel destination, largely due to the presence of San José State University but also due to some redevelopment downtown. The San José CBD has experienced some residential redevelopment in recent years. One of the interviewees pointed to twelve CBD blocks cleared in the 1960s for redevelopment that remained vacant until recently. Today, five-story condominiums are being developed on the sites, and pedestrian traffic has increased in the CBD.

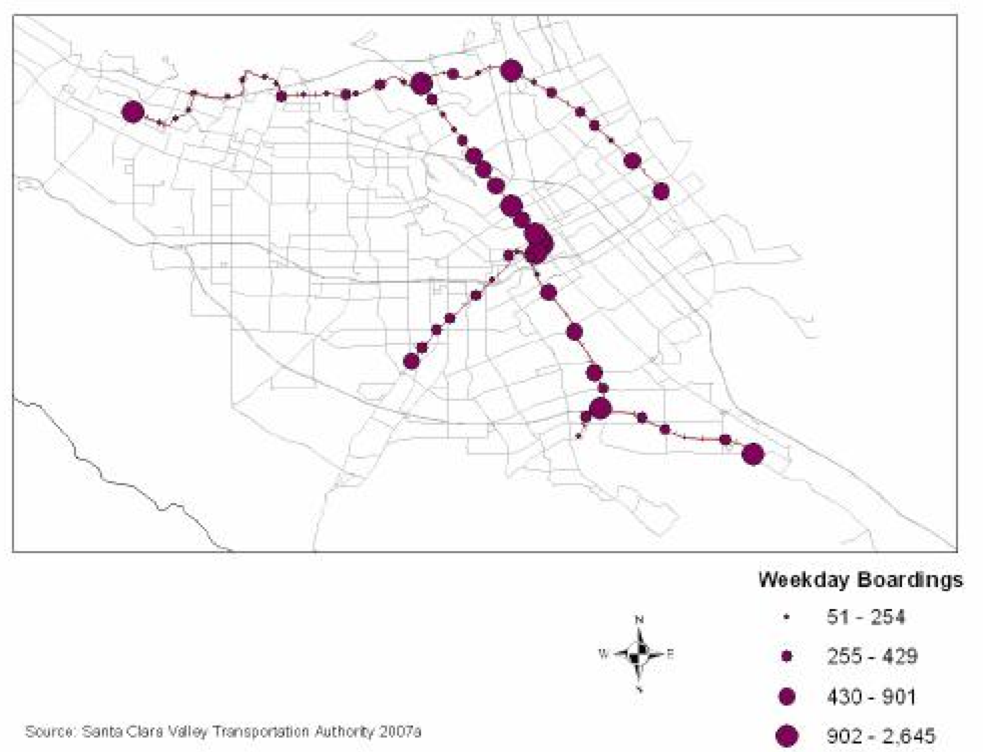


Figure 148 VTA average weekday LRT boardings (by station) (2007)

Transit and Development

The San José area has actively promoted transit-oriented development (TOD) both as an alternative to sprawled development and as a way to increase transit ridership. One interviewee noted that TOD is starting to occur, but he lamented that better TODs are not being built near transit.[251] This contact spoke favorably about development of high-density housing (20-story towers) in downtown San José. He also noted that there are large TOD villages planned for the BART extension, including by Calthorpe. Both interviewees see TOD as leading to increased transit ridership, although both also emphasized that ridership is strongly influenced by employment conditions and highway congestion.[252] The authors are unaware of any systematic evaluation of TOD's effects on VTA ridership.

Public Attitude Toward Transit

The study's interviewees believe the public is generally favorable to transit. One interviewee pointed to the high level of public support for BART (70% support) as indicative of the public's favorable attitude toward transit.

DISCUSSION

This study's examination of San José reveals that the alignment of the LRT follows, at least roughly, the patterns of population and employment shown in Figure 142 and Figure 143. The trunk line between Tasman station and the Convention Center station and the Winchester leg of the LRT are both located in close proximity to major employment centers. The line that runs between the Convention Center station and Santa Teresa station is located in close proximity to major residential concentrations. The line to Mountain View is also located near major employment centers, although the LRT follows a circuitous path to reach Mountain View. The east side line to Alum Rock appears to serve a populous corridor as well as a large regional mall. So, on balance, LRT appears to have been placed in many of the right kinds of corridors.

Two other positive developments are also worth noting. First, the San José CBD, a focal point for the transit system, has grown in recent years from a very weak CBD to one of modest size. Second, employers in many suburban areas are taking advantage of LRT's presence near their own sites and running shuttle services to connect the LRT stations to their offices.

Despite the positive developments, both LRT and the combined bus-LRT transit system are not performing well when compared to the other study areas. The authors have several explanations for the underperformance of VTA's LRT and combined bus-LRT service. First, rail needs to be faster than the buses it replaces in order to be attractive to patrons. Essentially, LRT should approximate the speed of a non-stop express bus. Unfortunately, the LRT in San José is plagued by poor speeds due to the restrictions on speed in the CBD and due to circuitous routing in many parts of the system, most notably along the line to Mountain View.

Second, VTA has low-quality bus service. Most bus routes have long, irregular headways, which make it difficult to devise timed connections with LRT. As a consequence, integration of bus and rail service is impeded. Buses should operate to complement LRT, and vice versa, but the poor quality of bus service makes this hard to achieve in San José. In other study areas, buses act as feeders to LRT and LRT feeds buses, thereby improving the productivity of both modes. The lack of this capability in San José depresses the productivity of both modes.

Third, LRT suffers from access problems in many portions of the alignment. The LRT's placement in a freeway median poses serious access challenges to LRT patrons accessing the line as pedestrians or bus riders, or for LRT patrons wishing to depart the LRT to make bus transfers or access final destinations.

Fourth, as the authors discussed earlier, buses do not connect sizable parts of the residential districts of Santa Clara County with the light rail line spine, which, if they did so, could function as a distributor to a large number of jobs. It is as though the ribs have been broken off the spine and lie more or less parallel to it. This quality is particularly pronounced for the populous west side of the valley, north of the CBD. Just to the east of this area runs the north-south Guadalupe Corridor light rail line with stations at major employers. It would be a natural for east-west buses to run through the populous areas west of the Guadalupe Corridor before intersecting with it. If they did, bus passengers could change to trains to access jobs both north and south. By and large, such connections are missing. Figure 149 provides a concept map of how bus routes might be developed to connect with both the LRT (shown in red) and the Caltrain (approximate location shown in blue) to form a more integrated system that connects residential and employment centers to one another.

Finally, San José's inclusion in the much-larger San Francisco Bay Area poses challenges to VTA. Jobs outside Santa Clara County attract many residents from within Santa Clara County, while many jobs within the county are filled by workers who live outside the county. Thus, San José is like San Diego in that its transit service area does not provide connections between all the major origin and destination centers. This would limit its transit patronage compared to a stand-alone region like Portland, where the transit agency can more easily connect all the major activity centers to one another.

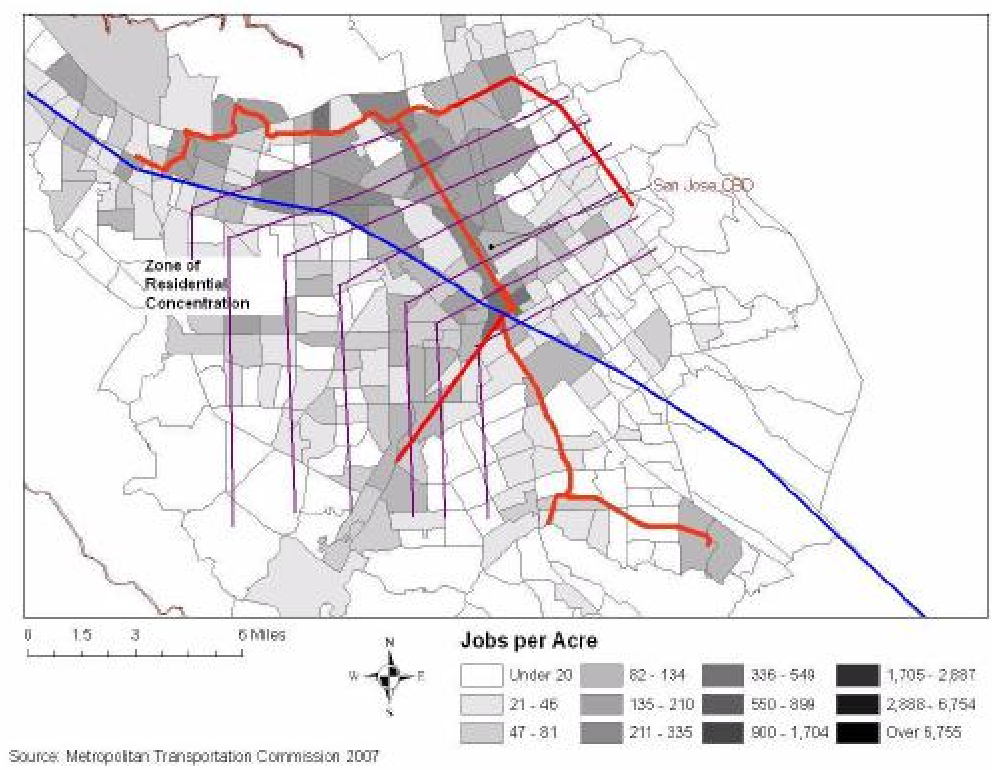


Figure 149 Concept map of new bus connections to LRT and Caltrain in San José and their relation to employment (2005)

APPENDIX L
INTERVIEW QUESTIONS

The following pages contain the questions used during telephone interviews of key informants in each of the study areas. We submitted these questions to our informants prior to conducting the interview. The names of interviewees are listed for each study area.

ATLANTA, GEORGIA

Interviewees: Mr. Paul Grether of Metropolitan Atlanta Rapid Transit Authority (MARTA) and Mr. Cain Williamson of Atlanta Regional Commission (ARC)

1. Does Atlanta have a regional transit vision?
2. Who articulates this vision (short term, long term)?
3. What has the vision been? Is it changing?
4. Does MARTA have a transit vision?
5. Does MARTA's vision differ from the regional vision?
6. What is MARTA's relationship to GRTA?
7. Does MARTA have any multidestination non-rail regional transit routes?
8. How active is the Transit Planning Board? Who composes it? Who has political power on it? Has it articulated a vision? What is it?
9. Atlanta is characterized by a distinctive north-south development pattern, with job-rich areas in the north and primarily minority communities in the south. How has this pattern affected MARTA bus and rail planning?
10. Does MARTA have any strategies for connecting major employment concentrations outside its service area to the core of the region?
11. What role has the business community played in rail development in Atlanta? Have suburban business interests been active (either for or against)?
12. What were/are the objectives of rail transit development in your metropolitan area? Have these objectives changed over time? If so, how?
13. What is the relationship of rail planning to highway planning? Are both new highways and new rail lines seen as necessary for your region now? In the past? Were rail lines implemented as the result of an anti-highway movement?
14. How has rail affected development in your region?
15. How would you characterize public attitude to transit in your region? Has the willingness of the public to support transit changed since rail transit has been implemented?

16. According to our research, MARTA has aggressively restructured bus service when rail segments have opened. Is this true? If so, what was the genesis of the restructuring? How has it worked out?
17. Cain Williamson of ARC told us that MARTA is engaging/will engage in a comprehensive route restructuring. Can you describe the thinking/vision underlying this effort?
18. Are your region's TODs primarily oriented to residential development, or are they primarily oriented to commercial development?
19. Have there been any evaluations about the effects of TOD on ridership (versus, for example, the effects of park and ride lots on ridership)?
20. What are your sources for operating funding? How do they affect transit planning in your area? (In terms of goals, expansion plans, contraction plans, route reorientation plans.)
21. How is GRTA express bus service funded?
22. How does your agency view transfers (opportunity, necessary evil)?
23. Do you charge for transfers? Why? Why not?
24. Is your transit network designed to facilitate transfers or to avoid them?
25. Do you collect transfer rate information about bus-to-rail, rail-to-bus, or bus-to-bus transfers? Could we obtain it?
26. What is the composition of transit ridership in terms of trip type, income, time of day? For the rail lines by themselves? For the bus system by itself?
27. Has rail made ridership more or less oriented to the transit dependent? Has rail made it more of less oriented to the choice rider?
28. In what part of your region and on what modes is your ridership growing today? What part of your customer base is growing? Where are declines happening?

DALLAS-FORT WORTH, TEXAS

Interviewees: Mr. Douglas Allen of Dallas Area Rapid Transit (DART) and Mr. Gary Hufstedler Dallas Area Rapid Transit (DART)

1. How would you characterize the regional vision for transit? Who articulates this vision?
2. How active are private entities in the development of the regional vision? How has the regional vision evolved?
3. How has the position of the business community toward transit changed? What is the current attitude?
4. What role was/is bus supposed to play in regional transit?
5. What role was/is LRT supposed to play? Is LRT seen as a stand-alone system fed by park and ride lots or as part of a network that features a lot of transferring from buses?
6. DART has a number of rail extension projects in the works. What does DART hope to achieve with these projects?

7. What role is commuter rail supposed to play in regional transit?
8. Dallas is characterized by a distinctive north-south development pattern with job-rich suburbs to the north and minority communities to the south. We understand that this spatial pattern had an important political expression during the rail planning process, when it focused attention on north-south corridor development as opposed to east-west development. Could you comment on this history? How do north-south development pattern differences affect current service planning?
9. Dallas has restructured its service to more of a multidestination grid pattern and less of a radial one. Could you comment on the genesis of the restructuring and the objectives of the restructuring? For example, was it done primarily as part of the light rail projects, or would it have happened anyway?
10. What was the original rationale for the restructuring? How would you assess the results of the restructuring? Have there been unanticipated results?
11. Was there any thought that people might transfer from rail to bus to reach suburban destinations? Is your transit network structured in such a way that this kind of trip could be served by transit? If yes, have you seen evidence that this kind of travel is occurring on your system?
12. How would you characterize the nature of planning coordination, service coordination, and/or fare integration between modes of DART, and between DART and the other providers in the region?
13. What are DART's strategies with respect to suburban service planning?
14. Does DART have any inter-suburban express bus service?
15. How would you characterize your current ridership market? Your target ridership market?
16. Do you have a current breakdown of current ridership that distinguishes CBD-bound ridership from non-CBD ridership? Could we obtain these data?
17. Have there been studies about non-traditional ridership patterns (reverse commute) or destinations?
18. Do the characteristics of riders differ between light rail, commuter rail, and bus riders? (In terms of income, time of day when they travel, where they go?)
19. In terms of different types of transit services (for example, commuter rail, light rail, express bus, local bus not going downtown but connected to DART, local bus going downtown, other) where is ridership growing, and where is it declining?
20. Do you have any information about bus-to-bus and/or bus-to-rail transfer rates? Have there been any special studies about transfer rates?
21. Has DART evaluated the productivity/performance of its cross town and radial routes?
22. When/where did the idea for LRT originate?

23. How would you characterize DART's standing in the region, both before and after the opening of the first light rail line? Is there still support for expanding the rail system as DART hopes to have it expanded?
24. One of the goals of rail (according to politicians in the 1990s) was revitalization of the Dallas CBD. Do you have any data on CBD development (or employment or retail sales) before and after rail service began?
25. Dallas is known for TOD development efforts around its rail stations. Have there been any evaluation about the effects of TOD on ridership?

DENVER, COLORADO

Interviewees: Mr. Robert Rynerson of Denver Regional Transit District (RTD) and Mr. Bill Van Meter of Denver Regional Transit District (RTD)

1. What is the regional transit vision in Denver? How has that vision evolved?
2. What were/are the objectives of rail transit development in your metropolitan area? Have these objectives changed over time? If so, how?
3. What is the relationship of rail planning to highway planning? Are both new highways and new rail lines seen as necessary for your region now? In the past? Were rail lines implemented as the result of an anti-highway movement?
4. RTD shifted from a radial to more of a multidestination, grid structure in the late 1970s. Do you have any insights as to the inspiration for the shift? Its objectives? Whether or not the objectives were achieved?
5. What kinds of route restructuring has RTD undertaken with recent rail expansions? What was the rationale? Has this restructuring been effective/not? Efficient/not? Have there been any studies?
6. Denver's LRT system is different than many other cities in that many lines operate in freeway medians, but there is high connectivity to destinations. Our observation from statistics is that this is working in Denver, but is not in places like San Jose. To what do you attribute your success?
7. How did you provide pedestrian connections between T-Rex and the adjacent activity centers in the corridor, given its location in a freeway median? Have these connections been effective/successful?
8. Union Station appears as an emerging hub in RTD's planning efforts. What is the philosophy behind this development?
9. What have been the primary objectives behind the Transit Mall? How effective do you think the Mall has been in meeting its objectives?
10. RTD appears to have focused more attention in recent years on providing CBD service. Would you agree with this characterization? If so, what is the rationale behind the shift?

11. How would you characterize public attitude to transit in your region? Has the willingness of the public to support transit changed since rail transit has been implemented?
12. How has rail affected development in your region?
13. Have there been any evaluations about the effects of TOD on ridership?
14. What are your sources for operating funding? How do they affect transit planning in your area?
15. How does your agency view transfers (opportunity, necessary evil)?
16. Do you charge for transfers? Why? Why not?
17. Is your transit network designed to facilitate transfers or to avoid them?
18. Do you collect transfer rate information about bus-to-rail, rail-to-bus, or bus-to-bus transfers? Could we obtain it?
19. What is the composition of transit ridership in terms of trip type, income, time of day? For the rail lines by themselves? For the system as a whole; for the bus system?
20. Has rail made ridership more or less oriented to the transit dependent?
21. Has rail made it more of less oriented to the choice rider?
22. In what part of your region and on what modes is your ridership growing today? What part of your customer base is growing? Where are declines happening?

MIAMI, FLORIDA

Interviewees: Mr. Bob Pearsall of Miami-Dade Transit (MDT), Mr. Clark Turner of Florida Department of Community Affairs, and Mr. Jeff Weidner of Florida Department of Transportation

1. Is there a regional (multi-county) transit vision in the Miami metropolitan area? If so, what is this vision? Who articulates this vision? If no regional vision, why not?
2. There are a number of transit agencies in the region. This is similar to the situation in San Diego. However, in San Diego, there has been an agency to coordinate services. There seems to be no agency that plays this role in southeast Florida. Do you see the South Florida Regional Transportation Authority playing such a role? How would you characterize the role played by the South Florida Regional Transportation Authority?
3. How would you characterize the nature of regional coordination of transit planning and operations? Is it possible for someone in Dade County, for example, to use transit to reach a job in Broward or Palm Beach County?
4. What role does rail transit play in your overall service strategy? Local buses? Busway/BRT services? The Metro Mover? Tri-Rail? The Florida East Coast Railroad? Will FEC replace or complement Tri-Rail?

5. How would you characterize the public attitude to transit in southeast Florida? Has the willingness of the public to support transit changed since rail transit has been implemented?
6. What was the vision for transit in Miami-Dade County the 1970s? How did rail transit fit into the vision? How has the regional transit vision changed? How does rail fit into the current transit vision?
7. What is the relationship of rail planning to highway planning? Are both new highways and new rail lines seen as necessary for your region now? In the past? Were rail lines implemented as the result of an anti-highway movement?
8. How was the alignment for the rail system determined? Why didn't the rail line go to Miami Beach? Was rail viewed as a development tool? How has rail affected development?
9. Why wasn't Metro Rail planned to have more stations in the downtown? Why was Metro Mover implemented instead?
10. When the transit operators consolidated in the 1970s, were the routes restructured? If so, were they restructured to a grid? What was the objective? Was this achieved? What were the other consequences?
11. In the late 1970s, there was discussion that when rail opened, bus service would be structured so that bus and rail service complemented each other. How so?
12. How was bus service restructured with rail system development? What was the objective? Was it achieved? What were the consequences?
13. In 1984, there was a proposal in the Long Range Transportation Plan Update to shift to a multidestination transit system. What was the outcome of this proposal? Was this proposal related to the Network 86 restructuring proposal?
14. What was the vision underlying the Network 86 restructuring proposal? What did it propose? Why was it defeated? Were there any subsequent attempts to revisit its ideas?
15. In 1994, CUTR proposed truncating CBD-bound routes and relying more on rail (Heavy Rail and the Metro Mover). What, if anything, happened as a result of these recommendations?
16. In 1974, there was a proposal for a Transit Mall on Flagler Street. What was the history of this proposal?
17. What was the philosophy behind development of the busway?
18. What do you see as the target ridership markets of Miami-Dade Transit, Broward County Transit, Tri-Rail, and Palm Tran? How do the target markets differ from agency to agency?
19. What types of transit services are enjoying patronage growth?
20. What types of transit services are seeing patronage decline?
21. Are there geographic areas where transit patronage is growing? declining?

22. Now that Tri-Rail is completing double tracking and beginning to offer all-day service, has patronage increased as a result?
23. For Miami-Dade Transit, how significant is the system's deteriorating reliability as a negative influence on ridership?
24. Around 1996, Broward County Transit (BCT) restructured its transit service to a grid system. Can you tell us about the thinking behind this effort? Its history? Its relationship to route restructuring in Miami-Dade County? Its results? What was the county's role here? How was this financed?
25. How, if at all, does BCT utilize Tri-Rail in its service strategy?
26. Is the route along US 441 still BCT's highest ridership route?
27. To what extent do Community Circulators contribute to BCT's patronage?
28. Are Miami's TODs primarily oriented to residential development, or are they primarily oriented to commercial development? (note: population-serving businesses such as dry cleaners and coffee houses do not count as "mixed use.")
29. Have there been any evaluations about the effects of TOD on ridership?
30. How would you characterize the public attitude to transit in Miami? Has the willingness of the public to support transit changed since rail transit has been implemented?
31. How would you characterize the roles played by the Citizens Independent Transportation Trust in your current planning and service strategies? Has their involvement improved the planning process, been neutral, made it more difficult? How so?
32. How would you characterize the roles played by the Office of Public Transportation Management in your current planning and service strategies? Has their involvement improved the planning process, been neutral, made it more difficult? How so?
33. How does your agency view transfers (opportunity, necessary evil)?
34. Do you charge for transfers? Why? Why not?
35. Is your transit network designed to facilitate transfers or to avoid them?
36. Do you collect transfer rate information about bus-to-rail, rail-to-bus, or bus-to-bus transfers? Could we obtain it?
37. What is the composition of transit ridership in terms of trip type, income, time of day? for the rail lines by themselves? For the system as a whole? For the bus system?
38. Has rail made ridership more or less oriented to the transit dependent?
39. Has rail made it more of less oriented to the choice rider?
40. In what part of your region and on what modes is your ridership growing today? What part of your customer base is growing? Where are declines happening?

MINNEAPOLIS-SAINT PAUL, MINNESOTA

Interviewees: Mr. Derrick Crider of Carter-Burgess and Mr. John Dillery of Metro Transit

1. Our sense is that for many years, the vision for transit was to provide high-speed express buses from suburbs into CBD. Is this an accurate characterization?
2. If it is accurate, how did this vision emerge?
3. Has this vision of service been consistent since public takeover of transit?
4. At the time of public takeover, did service expand a lot? If yes, what form did that expansion take?
5. Was the express bus service strategy successful—at first—in terms of effect on ridership and productivity?
6. If successful at first, how did its performance change?
7. If falling to what do you attribute its declining performance? Decentralization?
8. What are the characteristics of ridership on express bus (peak vs. off peak, weekday vs. weekend)?
9. How does LRT relate to the express bus service concept? Or, does it represent the beginning of a different service concept?
10. LRT patronage is much higher than anticipated, especially on weekends. Do you have any insight as to why this has occurred? Does combination of LRT and bus represent a new source of patrons (in terms of market)?
11. Did you restructure bus service around Hiawatha LRT prior to, at time of, or since its opening?
12. Throughout the history of transit planning in the region, the desire to maintain and enhance the attractiveness of the CBD has been a predominant goal. Is this still a focus of transit planning?
13. What is the current assessment about the effects of the Nicollet Mall on CBD economic activity and transit patronage?
14. There is a major route restructuring under way. What prompted the restructuring? (Low express route productivity?) What do you hope to achieve?
15. Transit planning history in Minneapolis is characterized by lots of plans but little action until the late 1990s. Why the sudden action in the late 1990s? What happened to spur action in 1998 and 1999? Who were the important actors?
16. For a period, regional rail authorities played a part in rail transit planning. Do you have any insights as to the role they played? Are they still active? What role do they play?
17. What is the status of TOD development? If have you have TODs, have there been any evaluations about their effects on ridership?

PITTSBURGH, PENNSYLVANIA

Interviewees: Mr. Edson Tennyson (former Deputy Secretary of Transportation, Commonwealth of Pennsylvania) and Mr. David Wohlwill of Port Authority of Allegheny County Transit (PAT)

1. How would you characterize the regional vision for transit? Who articulates this vision?
2. How active are private entities in the development of the regional vision? How has the regional vision evolved?
3. The website reports on a Transit Visioning Study. Is this the 2030 study?
4. How has the position of the business community toward transit changed? What is the current attitude?
5. What role was/is bus supposed to play in regional transit?
6. What role were/are busways supposed to play in regional transit?
7. What role was/is LRT supposed to play? Is LRT seen as a stand-alone system fed by park and ride lots or as part of a network that features a lot of transferring from buses?
8. How would you characterize the transit system—as a grid with an LRT trunk or as radial with bus and LRT focused on serving the CBD?
9. What is the philosophy underlying your trunk and feeder strategy?
10. Was bus service restructured when LRT came online?
11. Was there any thought that people might transfer from rail to bus to reach suburban destinations? Is your transit network structured in such a way that this kind of trip could be served by transit? If yes, have you seen evidence that this kind of travel is occurring on your system?
12. Much of the recent regional growth has occurred to the western part of the region, including along I-279 and PA60. What service currently exists or is planned for these areas in order to get people to these destinations?
13. How would you characterize the nature/extent of suburb-to-suburb transit service? Are there plans to increase/improve suburb-to-suburb service?
14. How would you characterize the nature/extent of regional transit connectivity? (Does Port Authority Transit connect with the suburban county operators)?
15. In 1997, Port Authority implemented a "through route" (500 Highland Park-Bellevue) as an experiment to eliminate the need to transfer downtown. How did this innovation work out? Were other through routes implemented/considered?
16. Port Authority's ACCESS paratransit carries a very large number of riders. What are the costs (to Port Authority) of this service? Have there been any thoughts of changing the nature of ACCESS service (in any way)?
17. The Port Authority is currently in a fiscal crisis and has outlined a series of service reductions. Has there been any thought about taking the opportunity presented by the

crisis to fundamentally rethink the structure of the bus service? (It appears to us that you have a lot of duplicative service, and are leaving many areas of the region unserved.)

18. If you had money available to implement new service, what would your first priority be?
19. How would you characterize your current ridership market? Your target ridership market?
20. Do you have a current breakdown of current ridership that distinguishes CBD-bound ridership from non-CBD ridership? Could we obtain these data?
21. What is the spread of ridership (by time of day) going into the CBD? How has this changed over time?
22. Have there been studies about non-traditional ridership patterns (reverse commute; suburb-to-suburb)?
23. Pittsburgh invested heavily in busways. What was the vision behind this strategy? What market were/are you trying to tap? How have bus services been restructured around busways? What are current busway extension plans (the 2030 document discusses possible extensions)?
24. Who is riding the busways today? The 2003 West Busway evaluation stated that 78 percent of trips were work trips. Where are these jobs located? What proportions are CBD versus suburban jobs?
25. The 2003 West Busway evaluation statistics indicate that busways serve weekday, peak-period trips. Do your current statistics paint the same picture? How does this ridership pattern compare to your light rail ridership?
26. The busways are designed to funnel people into the CBD. Can people use them in the reverse direction to reach suburban employment centers? Could someone living in the eastern part of the region use transit to access jobs in the western part of the region?
27. Is there much on/off activity at busway online stations? Is there much transferring between busway routes and non-busway routes that run perpendicular to the busway?
28. Is there much interlining of other bus and LRT patronage to the West Busway?
29. How has ridership on the busways changed over time?
30. When/where did the idea for LRT originate?
31. Pittsburgh invested in LRT (including the North Shore Connector). What is the vision behind this strategy? What market were/are you trying to tap? How have (will) bus services been (be) restructured around LRT? Are there future LRT extensions planned?
32. What is the role of the South Hills T?
33. Did Pittsburgh give any thought to building LRT on a new alignment, as opposed to reconstructing the existing alignment (at $20 million/mile)?
34. The 2030 study compares a Trend development scenario to a Focused Growth Scenario. The Trend scenario consists of continued sprawl development while the Focused Growth Scenario assumes development will occur at higher densities. The transit plan is then outlined to serve the focused growth scenario, and is projected to increase ridership 55

percent (versus 20 percent under the Trend Scenario). Did you give any thought to developing a set of strategies to better serve development along the Trend lines, as that is what future development in the region is likely to be?

35. The 2030 study notes more express buses and park and rides as the essential strategies here. Was there any rethinking about, for example, better serving the suburban development (as opposed to doing what seems to be) more CBD-oriented service?
36. There are certain aspects of the planning under the Focused Growth scenario (in the 2030 study) that might be relevant currently, including more suburban focused service. Any plans to do this? Any plans to adapt any other transit recommendations from the Focused Growth Scenario to current or likely future conditions?
37. In a 2003 evaluation of the West Busway for FTA, the consultants discussed regional efforts to encourage development around the busway park-and-ride lots, especially in Carnegie. What have been the results of these efforts?

PORTLAND, OREGON

Interviewees: Mr. Jim Howell (architect, neighborhood activist, and former Tri-Met planner) and Mr. Ken Zatarain of Tri-Met

1. What is the current regional vision for transit in the Portland region?
2. Is Portland still attempting to carry out a multidestination transit vision?
3. What entity is responsible for long-range transit planning? Short-range transit planning? How effective have they been?
4. What is the relationship of rail planning to highway planning today?
5. What were/are the objectives of rail transit development in Portland? Have these objectives changed over time? If so, how?
6. Should all the LRT lines serve the CBD?
7. One of the rationales for the Transit Mall was to improve the economic condition of the CBD. Do you have any evaluations of the effects of the mall on employment or retail activity in the CBD when it was created? To the present? What is your take on current efforts to expand the Mall?
8. Clark County, Washington is growing rapidly. Does this pose challenges to regional efforts to continue to increase transit use? Should there be LRT or BRT on I-205 into Clark County? Should the Yellow Line have been placed in I-205 instead of on Interstate Avenue?
9. Tri-Met (and Portland) have experienced near-continuous total transit ridership growth (in excess of population growth) during a period when other cities have experienced falling or stagnant ridership. To what do you attribute the continued growth in overall ridership?
10. The Tri-Met system statistics clearly indicate that the service changes that accompanied the opening of the LRT to the western suburbs had a very large effect on patronage

(passenger miles increased 44 million to 322.4 million) and improved overall system productivity (boardings per vehicle hour and fare recovery ratio both increased). Tri-Met essentially gained large ridership with relatively modest increase in service (1.8 million). To what do you attribute these large ridership increases and performance improvements?

11. How would you characterize the public attitude to transit in Portland?
12. How do you view Tri-Met's treatment of transfers?
13. Portland is well known for its land use policies and the many transit-oriented development initiatives it has undertaken. What is your take on TOD's contribution to ridership?
14. We understand that the primary sources of operating support are the payroll tax and fares. How has the structure of the payroll tax affected the nature and amount of service you have provided? Do you feel constrained? If you had additional money, what kind of service(s) would you spend it on?

SACRAMENTO, CALIFORNIA

Interviewees: Mr. Anthony Palmere of Unitrans in Davis, California (formerly of Sacramento Regional Transit District) and Mr. Michael Wiley of Sacramento Regional Transit District (RT)

1. How would you characterize the evolution of the transit system in Sacramento in the years prior to your arrival there?
2. Are you familiar with the transit master plan prepared circa 1977–1979 under the direction of Bob Koski of RT. SRAPC adopted the plan around 1979. If you are familiar with it, did it disappear from importance when the sales tax measure for transit failed in 1979? Was it ever referred to subsequently for guidance re system expansion?
3. That plan evidently embraced multi-destination transit, and around 1979–80 a timed transfer center was implemented at Florin Mall in three stages, with many of the routes in the south restructured around it. Did this work out?
4. Why was Nelson brought in as GM? What were his policies?
5. What is your understanding of the role that LRT was to play in the restructuring of the transit system? (Tap new markets? Increase system productivity?)
6. Why was Boggs brought in as GM after Nelson left? Why did Boggs hire Wendy Hoyt?
7. It appears to some that Boggs did not embrace the ideas of Schumann and Nelson for restructuring the bus system around light rail. Is this so? If this is so, how could this have happened when the same board who hired Nelson and believed in his policies then hired Boggs to replace him?
8. What changes in direction did Tom Matoff initiate when he came on board? Short term? Long term?
9. Was Route 1 a successful initiative?

10. Matoff launched a major planning effort to expand the amount of bus and rail service by a large amount, but I cannot tell what happened to the plan, which was not quite finished when Tom left. It does appear that the idea of greatly expanding the scope of the transit system was not embraced. Could you comments on its fate?
11. Around 1990 Measure A, a sales tax increase, and shortly thereafter Proposition 116 passed. How did these new sources of funding affect the fortunes of RT?
12. After Matoff left, did commitment to multi-destination bus service decrease?
13. In recent years RT's performance stats have indicated ridership not pacing population, productivity falling, and operating expense per passenger mile (in real terms) increasing. These stats generally improved after light rail was introduced and bus services were restructured. What is to account for the reversal of fortunes?
14. We note that the Folsom light rail line has been extended into an area rich in employment, creating the possibility of heavy ridership in the reverse peak direction, and yet there is no multi-destination bus system coordinated with the light rail extensions. Is this potential ridership market being ignored? Or, are employers providing shuttle services from stations?
15. We note that on Stockton Blvd., there is a 15-minute headway local route connecting the Florin Mall timed transfer center with downtown. We also note that in the last three or four years a new 15-minute headway route has been superimposed on this—presumably it is a form of BRT. Is this new service attracting ridership? Could those buses be used more productively elsewhere?
16. Why was Route 1 broken in half? Has this change affected its performance?

SALT LAKE CITY, UTAH

Interviewee: Mr. Mick Crandall of Utah Transit Authority (UTA)

1. How would you characterize the regional vision for transit? Who articulates this vision? How active are private entities in the development of the regional vision? How has the regional vision evolved?
2. How has the position of the business community toward transit changed? What is the current attitude?
3. What role was/is bus supposed to play in regional transit?
4. What role was/is LRT supposed to play? Is LRT seen as a stand-alone system fed by park and ride lots or as part of a network that features a lot of transferring from buses?
5. What role is commuter rail supposed to play in regional transit?
6. There is a major downtown development initiative called Downtown Rising. How would you characterize transit's relationship to these efforts? Is one of transit's primary roles to boost the status of the CBD?

7. How would you characterize the transit system—as a grid with an LRT trunk or as radial with bus and LRT focused on serving the CBD?
8. Was bus service restructured when LRT came online?
9. Was there any thought that people might transfer from rail to bus to reach suburban destinations? Is your transit network structured in such a way that this kind of trip could be served by transit? If yes, have you seen evidence that this kind of travel is occurring on your system?
10. There was discussion in August 2003 about potential bus route restructuring after ridership declined. Did any restructuring occur? If so, what was done? If not, why not?
11. There is a current bus system redesign. What prompted the redesign? What do you hope to achieve? How would you characterize the nature of the proposed changes?
12. LRT extension to Southwest. Do you plan to use this extension to access suburban employment (versus funnel people to CBD)? If so, how do you propose to connect employment centers and the rail stations?
13. How would you characterize your current ridership market? Your target ridership market?
14. Do you have a current breakdown of current ridership that distinguishes CBD-bound ridership from non-CBD ridership? Could we obtain these data?
15. Have there been studies about non-traditional ridership patterns (reverse commute) or destinations?
16. When/where did the idea for LRT originate?
17. How important was hosting the Olympics to getting LRT built in Salt Lake City?
18. LRT development was closely tied in with efforts starting in the late 1980s to reconstruct and widen I-15. This linkage between rail and road projects continued in November 2006's successful sales tax increase. How important was this linkage to rail's development? How did this linkage come about?
19. During the early 1990s, there was significant suburban political opposition to rail development. By March 1996, however, suburban positions changed. Why?
20. How important was the Mayor of Ogden in lining up suburban political support at the time of the 2000 sales tax election?
21. Back in the1990s, there was significant opposition in the state legislature to rail development. Was this opposition purely related to tax issues, or was something else at work? How was this opposition overcome?
22. In late 2005, Salt Lake City was lauded as a showcase for smart growth. What are the most prominent examples of smart growth in Salt Lake City? How important a role do smart growth efforts, and in particular TOD, play in your transit planning efforts/vision? When did this focus emerge? What is the strategy behind it?
23. Have there been any evaluations about the effects of smart growth/TOD strategies on ridership?

24. South Town Expo. What is this development? Is this a TOD development? Does it generate transit ridership?

SAN DIEGO, CALIFORNIA

Interviewee: Mr. William Lieberman (former Director of Planning, Metropolitan Transit Development Board, San Diego)

1. How would you characterize the regional vision for transit? Who articulates this vision? How active are private entities in the development of the regional vision? How has the regional vision evolved?
2. What is the role of the Regional Transit Vision (RTV) strategy in the region's transit vision?
3. How has the position of the business community toward transit changed? What is the current attitude? (both Centre City and regional, if you can discern a difference)
4. What role was/is bus supposed to play in regional transit? Why is bus-on-freeway chosen for the I15 corridor and LRT chosen for the I5 corridor heading north?
5. What role was/is LRT supposed to play? Is LRT seen as a stand-alone system fed by park and ride lots or as part of a network that features a lot of transferring from buses?
6. What role is commuter rail supposed to play in regional transit?
7. In general it appears that corridors that have been developed from bus to rail have developed heavy trunk patronage, but corridors that have remained as bus trunks (i.e. Route 20 in the I-15 corridor, or the various express buses serving the coastal corridor to UCSD and University Town Center) have remained with lackluster patronage. Is this an accurate characterization? If so, why is this?
8. There is significant employment activity in the I-15 corridor that is not currently much served by transit. Are there any plans to increase service to these employment clusters? If so, what are those plans? How can you make a trunk route in a freeway serve adjacent destinations? (Model of T-REX in Denver)
9. BRT is portrayed as a means for achieving the effects of LRT at lower cost, but we note that BRT proposals for the San Diego region each are in the several hundred million dollar range. At such cost, why are they being pursued?
10. How is the reorganization of transit and planning institutions that took place in the early 2000s working out? In terms of regional transit patronage in relation to population growth? In terms of productivity or cost per passenger mile? Is there a difference in performance between north and south county?
11. In 2006, MTS undertook a Comprehensive Operational Analysis (COA) that has led to significant route restructuring. What prompted the COA? What were the key findings of the COA?

12. In the wake of the COA, how (if at all) has the region's transit planning philosophy/strategy changed? Has the COA led to a stronger emphasis on some kinds of services versus others? Some destinations versus others?
13. Have the COA results changed in any way the Regional Transit Vision (RTV), as originally articulated in MTDB's Transit First and NCTD's Fast Forward strategies?
14. Over the years San Diego has restructured its service to more of a multidestination grid pattern and less of a radial one. Could you comment on the genesis of the restructuring and the objectives of the restructuring? For example, was it done primarily as part of the light rail projects, or would it have happened anyway? What was the original rationale for the restructuring (such as improve transit productivity)? How would you assess the results of the restructuring? Have there been unanticipated results?
15. Was there any thought that people might transfer from rail to bus to reach suburban destinations? Is your transit network structured in such a way that this kind of trip could be served by transit? If yes, have you seen evidence that this kind of travel is occurring on your system?
16. How would you characterize the nature of planning coordination, service coordination, and/or fare integration between agencies and modes in the San Diego region?
17. What are the San Diego region's strategies with respect to suburban service planning?
18. Does the San Diego region have any inter-suburban express bus service?
19. How would you characterize your current ridership market? Your target ridership market? We note that ridership on CBD-radial routes serving Centre City (most significantly on express bus routes, but not on light rail) is declining. Can you explain reasons for this?
20. Do you have a current breakdown of current ridership that distinguishes CBD-bound ridership from non-CBD ridership? Could we obtain these data?
21. Have there been studies about non-traditional ridership patterns (reverse commute) or destinations?
22. Do the characteristics of riders differ between light rail, commuter rail, and bus riders? (In terms of income, time of day when they travel, where they go?)
23. In terms of different types of transit services (for example, commuter rail, light rail, express bus, local bus not going downtown but connected to light rail, local bus going downtown, other) where is ridership growing, and where is it declining?
24. MTS released a study of the causes of ridership decline between 2001 and 2004. The study found that the biggest declines were in express services and downtown services. The study also said that the transit network was not aligned with current travel patterns—essentially that population and employment decentralized and the route structure was static. How (if at all) have the results of the study affected MTS service planning strategies and decisions?
25. Do you have any information about bus-to-bus and/or bus-to-rail transfer rates? Have there been any special studies about transfer rates?

26. Has MTDB/MTS evaluated the productivity/performance of its cross town and radial routes?
27. When/where did the idea for LRT originate?
28. How would you characterize MTDB/MTS's standing in the region, both before and after the opening of the first light rail line? Is there still support for expanding the rail system?
29. Promoters of a vibrant Centre City were indifferent at best about the possible coming of light rail in the late 1970s. Has that attitude changed as the system has expanded? Since 1981 Centre City has changed dramatically. Are there figures on employment and population trends in the Centre City, and is there an assessment of the success? Do you have any data on CBD development (or employment or retail sales) before and after rail service began?
30. What impact has the light rail surface operation had on business activity along it? Is there any planning to improve this issue?
31. San Diego light rail lines originally were not developed to stimulate land use change, but rather the main emphasis seemed to be to take people where they wanted to go. More recently there has been considerable TOD activity, particularly in the waterfront and convention areas, and in the Mission Valley. The Mission Valley also has considerable big box and auto-oriented activity that transit users can reach. Can you comment on the relative success of these types of developments in stimulating transit patronage? Is there any difference in experience between the Mission Valley area and the Convention Center area? If there is, can you speculate on why?

SAN JOSÉ, CALIFORNIA

Interviewees: Mr. Rod Diridon of the Mineta Transportation Institute (former Santa Clara County Supervisor) and Mr. David Minister (Project Manager for LRT Alternatives Analysis)

1. How would you characterize the San José area's vision for transit at the time you began your political career in the 1970s? Who articulated this vision?
2. What role did private sector entities play in the development of the vision? What was your vision for transit at the time? How has the San José area's vision for transit evolved since that time?
3. What is the role played by bus transit in the contemporary vision? What is the role played by light rail transit? What is the role played by commuter rail transit? How do these modes relate to one another under the contemporary transit vision? Do they relate the way you would like?
4. VTA is part of the general purpose county government. How has this arrangement affected transit development in San José?
5. When and why did light rail transit (LRT) emerge as a possible transit investment for the San José area?

6. What was the sequence of studies that led to LRT's actual adoption?
7. When did you move from systems design to alternatives analysis?
8. What was the vision of rail transit at the time?
9. Who were the proponents of rail transit?
10. What were the roles played by Modern Transit Society, Rod Diridon, Senator Alquist, and Norman Mineta?
11. What was your conception of the relationship between bus and rail at the time LRT was adopted?
12. How was LRT development connected with freeway development? (Note to selves: Focus on change from LRT in a parkway to LRT in a freeway in Guadalupe Corridor)
13. What were your plans for enabling people to access LRT under the original facility design? After the parkway became a freeway?
14. After the final LRT segment in the Guadalupe Corridor opened, what bus service changes were made?
15. What role was LRT supposed to play in the transit system?
16. How was LRT supposed to relate to the bus system? Was the bus system supposed to change in any way as LRT opened? If so, has it changed as LRT opened?
17. How would you characterize the transit system prior to LRT opened: focus on connecting residential suburbs to CBD, connecting residential suburbs to CBD and Silicon Valley job centers, some other focus? How has it changed since LRT opened?
18. In 1991, there was further discussion about bus restructuring. Did this occur? If so, what did it entail? What were the results?
19. How would you characterize the nature of service and/or fare coordination between VTA and other agencies that provide transit service in Santa Clara County?
20. How would you characterize the performance of the transit system today? To what do you attribute its present performance?
21. Are you aware of any service strategies being considered to improve overall system performance (increase ridership, improve productivity) on the VTA system?
22. If you had money available to make service changes or new investments, what would your top priorities be?
23. How would you characterize the transit system at the time: focus on connecting residential suburbs to CBD, connecting residential suburbs to CBD and Silicon Valley job centers, some other focus?
24. How would you characterize the performance of the transit system today? To what do you attribute its present performance?
25. Are you aware of what VTA is trying to do as a result of its Comprehensive Operations Analysis?

ENDNOTES

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ABBREVIATIONS AND ACRONYMS

3Ds	Density, Diversity, Design
AC Transit	Alameda Contra Costa Transit District
ACE	Altamont Commuter Express
ARC	Atlanta Regional Commission
BART	Bay Area Rapid Transit
BCT	Broward County Transit
BCTA	Beaver County Transit Authority
BRT	Bus Rapid Transit
BSRC	Behavioral Science Research Corporation
CBD	Central Business District
CCT	Cobb County Transit
CDOT	Colorado Department of Transportation
CITT	Citizen's Independent Transportation Trust
COA	Comprehensive Operations Analysis
COTA	Central Ohio Transit Authority
CPO	Comprehensive Planning Organization
C-Tran	Clayton County Transit (Atlanta) and Clark County Transit (Portland)
CUTR	Center for Urban Transportation Research
CVT	Chula Vista Transit
DART	Dallas Area Rapid Transit
DCTA	Denton County Transportation Authority
DOT	Department of Transportaion
DPZ	Department of Planning and Zoning
DRCOG	Denver Regional Council of Governments
FDOT	Florida Department of Transportation
FEC	Florida East Coast Railroad
FWTA	Fort Worth Transportation Authority
GCT	Gwinnett County Transit
GDOT	Georgia Department of Transportation
GGC	GG and C Bus Company, Inc.
GRTA	Georigia Regional Transit Authority
HOV	High Occupancy Vehicle
ITC	Intermodal Transit Center
JPAC	Joint Policy Advisory Committee
LDS	Church of Jesus Christ of Latter Day Saints
LR	Light Rail
LRT	Light Rail Transit
LRTP	Long Range Transportation Plan
MAC	Metro Area Connection
MARTA	Metropolitan Atlanta Rapid Transit Authority
MDT	Miani-Dade Transit
MPO	Metropolitan Planning Organization

MSA	Metropolitan Statistical Area
MTC	Metropolitan Transportation Commission
MTDB	Metropolitan Transit Development Board
MTS	Metropolitan Transit System
NCT	National City Transit
NCTCOG	North Central Texas Council of Governments
NCTD	North County Transit District
NTD	National Transportation Database
OMB	Office of Management and Budget
Palm Tran	Palm Beach Transit
PAT	Port Authority of Allegheny County Transit
PM	Passenger Mile
PRT	Personal Rapid Transit
PTP	People's Transportation Plan
RAD	Regional Analysis District
RT	Sacramento Regional Transit District
RTD	Regional Transportation District
SACOG	Sacramento Area Council of Governments
Samtrans	San Mateo County Transit District
SANDAG	San Diego Association of governments
SCE	Service Concept Element
SDTC	San Diego Transit Corporation
SDTI	San Diego Trolley, Inc.
SFRTA	South Florida Regional Transportation Authority
SPC	Southwestern Pennsylvania Commission
TAZ	Transportatoin (Traffic) Analysis Zone
TCA	Transit Construction Agency
TCRP	Transit Cooperative Research Program
TDA	Transportation Development Act
TDP	Transportation Development Plan
The T	Fort Worth Transportation Authority
TIP	Transportation Improvement Program
TOD	Transit-Oriented Development
TBP	Transit Planning Board
TRE	Trinity Railway Express
UMTA	Urban Mass Transportation Administration
UPT	Unlinked Passenger Trip
UTA	Utah Transit Authority
VTA	Santa Clara Valley Transportation Authority
WCTA	Westmoreland County Transit Authority
WFRC	Wasatch Front Regional Council
WMATA	Washington Metropolitan Transportation Authority

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Focus

This dissertation examines efforts to increase commuter rail ridership by improving and extending service, and the costs associated with these efforts.

Methodology

Many U.S. cities are improving their existing commuter rail systems or starting new commuter rail operations, in order to increase ridership. This dissertation uses Boston's MBTA system as a case study. Boston is a particularly interesting case study because it has been extremely successful at increasing rail use, more than tripling ridership between 1975 and 1999. The findings are based on an analysis of the demand for and costs of Boston's commuter rail service. The author developed an econometric model of Boston commuter rail ridership and used data on station-level ridership from 1980 to 1997.

Findings

The study suggests that approximately 80 percent of the recent ridership growth was due to MBTA fare policies and service improvements, and 20 percent was due to factors outside the MBTA's control. The cost of attracting riders on the existing system was generally lower than the cost of attracting riders by building extensions. Moreover, increasing transit ridership by improving commuter bus service is a more cost-effective way of increasing transit ridership rather than building new extensions. The model shows that policies to increase service frequency had the largest policy impact on ridership, followed by lowering fares.

Models of costs are developed to divide capital and operating costs into three components: costs needed to maintain the core system, costs needed to accommodate new riders, and costs needed to increase ridership on the core system. The analysis shows that the costs to maintain the core system were quite high, while the costs to increase ridership by improving service were significantly lower. The costs of increasing ridership by expanding the core system through new lines and extensions are then calculated and compared. Finally, a comparison of commuter bus and rail service in locations where both are present shows that the extension of rail service into areas which previously had private commuter bus service increased transit use by 100 percent to 300 percent. However, the subsidies for the commuter rail lines and extensions were significantly higher than the commuter bus subsidies.

Allen, Douglas A. and Gary D. Hufstedler. "Bus-and-Rail and All-Bus Transit Systems: Experience in Dallas and Houston, Texas, 1985 to 2003." *Transportation Research Record* 1986 (2006): 127–136.

Focus

The authors compare the ridership characteristics of the major transit systems serving Dallas and Houston. Both systems began as all-bus systems but they later added light rail service. Houston's transformation came later than the time period discussed in this paper.

Methodology

The authors obtained data from the transit agencies themselves (DART and Metro, respectively) and the National Transit Database. They compared the two systems in terms of unlinked passenger trips from 1985 to 2003. They also compared the two systems in terms of the proportion of riders carried on weekends.

Findings

The authors found that both systems experienced increased ridership over the period studied. The two systems have experienced similar ridership peaks and valleys. The authors report that DART's light rail system expansion resulted in overall transit ridership increases, despite some decline in bus transit ridership. Metro's heavy commitment to its all-bus system has resulted in both higher service and ridership levels than DART, although the two systems have comparable populations. In general, the authors conclude that light rail transit in Dallas has had a positive effect on transit ridership. The paper is purely descriptive and does not attempt to identify causes for the findings.

American Public Transit Association. *Building Better Communities*. Washington DC: American Public Transit Association, 1987.

Focus

This study focuses on a host of land use strategies that can integrate with transit planning.

Findings

The authors favor integration of land use and transit planning, although it may require changes to local ordinances, regulations, building codes and procedures. They suggest many land use strategies that allow public agencies and developers to integrate the impact of mass transit investments and private sector financial participation. They also explain efficient strategies for developers like subdivision and activity design strategies, travel demand strategies, and transportation management associations. They include designing policies, working with the investment community, urban design considerations, ordinances and regulations, comprehensive planning, developer-furnished improvements, adequate public facilities, etc. Finally, they conclude that if the land use planning is transit supportive then it can bring about an increase in transit ridership.

Babalik-Sutcliffe, Ela. "Urban Rail Systems: Analysis of the Factors Behind Success." *Transport Reviews* 22, no. 4 (2002): 415–447.

Focus

The author examines eight cities in the US, UK, and Canada in an effort to identify the factors responsible for success and failure in urban rail transit systems.

Methodology

The author selected the systems in Miami, St. Louis, San Diego, Sacramento, Vancouver, Tyne and Wear, Manchester, and Sheffield for study, which are cities with roughly similar populations. The author compares the cities in terms of population density, per capita income, car ownership per household, and annual trips by public transport (per capita). The author also compares the cities in terms of the physical characteristics of the rail system, looking at length, number of stops, nature of technology, service frequency, and fare arrangements.

The author evaluated the cities in terms of five objectives: attaining high patronage, being cost-effective, increasing total transit use, having a positive effect on land use and urban growth patterns, and helping to reduce car traffic. The author compared the systems in terms of forecast versus actual (1999) patronage and financial performance in 1998 (including operating cost per passenger and farebox recovery ratio).

Findings

The author finds Vancouver most successful, followed by San Diego and St. Louis in the US. Sacramento, by contrast, was criticized for its poor patronage relative to the other systems, its low cost-effectiveness, and its limited effect on land use. Miami ranked last, receiving a credit only for no decline in bus use after the rail system opened. Manchester performed best among the UK cities.

The author recognizes integration of buses with rail as a key factor for success. The author also notes development activity as key factors for success (transit-oriented development, joint development, redevelopment activity, etc).

Baum-Snow, Nathaniel and Matthew E. Kahn. "Effects of Urban Rail Transit Expansions: Evidence from Sixteen Cities, 1970–2000." Brookings-Wharton Papers on Urban Affairs (2005): 147–206.

Focus

The authors evaluate whether rail transit improvements made between 1970 and 2000 led to new transit ridership. They also provide estimates of the value of the new rail transit commuting option.

Methodology

The authors obtain data from the US Census, Bureau of Transportation Statistics, and local data sources. They define transit ridership using the journey-to-work mode shares. Their geographic unit is the census tract. They aggregate census tract data to produce Metropolitan Statistical Area (MSA) level statistics. The authors then estimate multivariate models (for each of 16 metropolitan areas) that predict transit mode share (at the tract level) as a function of distance to the central business district (CBD) and distance to the nearest rail line. The authors do not control for any other socio-economic factors.

Findings

The authors find decreasing marginal returns of new rail investments for all cities but Portland and Atlanta. They note that a network effects argument, wherein later infrastructure connects riders to a broader array of possible destinations, might explain these two cases. The authors find large potential commute time savings associated with the rail investments but little to no effect on pollution and congestion externalities.

Beimborn, Edward. *Guidelines for Transit Sensitive Suburban Land Use Design*. Washington DC: U.S. Department of Transportation, 1991.

Focus

This guidebook presents and explains various guidelines addressing land use design in suburban areas.

Methodology and Findings

Transit ridership keeps declining, partly due to its failure to capture riders in the suburbs. The dispersed land use pattern that exists there is the major reason responsible for the transit failure in suburbia. This guidebook introduces elements of successful transit and criteria for transit-sensitive suburban land use design. It presents a list of transit-oriented and transit-compatible land uses to be included in an area served by transit and which should be located elsewhere. It presents guidelines for land use policies, access policies and transit policies under two major frameworks: system planning and district planning. It further outlines administrative and policy guidelines for transit agencies and local government. It also presents implementation methods as well as a case study wherein the guidelines were applied to develop a successful transit-oriented development in an emerging suburban area in the City of Milwaukee.

Bernick, Michael and Robert Cervero. *Transit Villages in the 21st Century.* New York: McGraw-Hill, 1997.

Synopsis

The focus of the book is the emergence of transit villages (i.e. transit-oriented development) as a reaction to declining quality of life. The authors see the transit village concept as a way of achieving a host of social benefits, ranging from air quality to quality of life. The authors open the book with a discussion of the historic influences on contemporary transit villages. They then make their case for the numerous benefits of a transit village approach to urban development. The primary source of many benefits is the mode shift from solo auto use to transit and non-solo auto modes. The authors acknowledge that recent rail transit ridership forecasts have been very inaccurate, but they argue that the numbers might materialize if auto use was priced at its full social cost. They then summarize a host of earlier empirical and qualitative case study research, including their own work, on transit oriented development. Much of the work, including the same detailed case studies, can also be found in Cervero's The Transit Metropolis published a year later. The lessons are similar to Cervero's other work on the subject-namely that transit-oriented developments can lead to increased transit ridership and also promote a wide array of societal benefits.

Botte Bates, Toni and Paul Jablonski. "San Diego Trolley's New Green Line: Early Success for a Distinctive Service." Paper presented at the 86th annual meeting of the Transportation Research Board, 2006.

Focus

The authors examine ridership patterns on the San Diego Trolley's Green Line, which opened in July 2005. The Green Line is a non-radial corridor that does not serve downtown San Diego, but does serve a number of regional activity centers in the Mission Valley corridor. The line also fills an earlier gap in the rail network and thus permits more direct travel for some trips.

Methodology

The authors examine the results of two surveys. The first survey was an on-board survey of Green Line Riders. During four days in October 2005, each trolley trip had one car surveyed. All riders over age 12 were offered a survey, available in English and Spanish. Of 8,000 surveys distributed, around 3,500 surveys were analyzed. The second survey was a web-based survey of students at San Diego State University (SDSU), a major activity center on the Green Line. Just under 400 students completed the survey, 90 percent of whom had used a transit bus or trolley during the school year.

Findings

From the on-board survey, the authors found that: 1) the Green Line serves a disproportionately higher share of school trips and lower share of shopping and recreational trips than the trolley system as a whole; 2) nearly 40 percent of Green Line riders did not ride transit before the line opened; 3) prior transit riders increased their frequency of transit use; and 4) users' shift from automobiles to Green Line diverted 4,000 daily auto trips to transit. From the student survey, the authors found that: 1) student respondents used transit much more frequently after the Green Line opened; 2) half of student respondents used a College Semester Pass (a discounted fare arrangement with SDSU); 3) more than two-thirds of student respondents had a car available to use; and 4) most students use transit to get to class or to reach off-campus shopping and entertainment destinations. The key finding is that the Green Line is reaching an important transit ridership market, many of whose members appear to be choice riders.

Brown, Jeffrey and Dristi Neog. "Reexamining the Link Between Urban Structure and Transit Ridership in the United States." Tallahassee, FL: Florida Planning and Development Lab, Florida State University, 2007.

Focus

Controlling for urban area density, unemployment rate, motor fuel prices, transit service frequency, transit service coverage, and the percent of households that do not own an automobile, this study examines the relationship between urban structure (defined as percent of MSA employment in the CBD) and two measures of transit patronage (passenger kilometers per capita, transit journey-to-work mode share) in 1990 and 2000 for all US metropolitan statistical areas (MSAs) with more than 500,000 persons.

Methodology

The authors collected data from the US Bureau of Economic Analysis, U.S. Bureau of Labor Statistics, U.S. Census Bureau, and National Transit Database. They obtained the following variables:

PKM_PC = Passenger kilometers per capita (aggregated for all agencies in the MSA)

JTW_MS = Transit journey-to-work mode share (aggregated for all counties in the MSA)

CBDEMPSHARE = percent of MSA employment in the CBD

FARE_KM = Fare revenue per passenger kilometer (inflation-adjusted to 2005 dollars, aggregated for all agencies in the MSA)

FREQUENCY = Service frequency, defined as the ratio of vehicle kilometers to route kilometers (aggregated for all agencies in the MSA)

COVERAGE = Service coverage, defined as the ratio of route kilometers to population (aggregated for all agencies in the MSA)

CARLESS_HH = Percent of MSA households that do not own an automobile (aggregated for all counties in the MSA)

UNEMPLOY = Unemployment rate (by MSA)

FUEL = Motor fuel price index (by MSA)

UZADENS_KM = Urbanized area density, defined as persons per square kilometer

The authors used these variables to estimate multivariate models for each of the two transit ridership variables for 1990 and 2000 for three different groups of MSAs: all MSAs, MSAs with 1 million to 5 million persons, and MSAs with 500,000 to 1 million persons. The authors used the natural log transformations of the variables in order to interpret the coefficients as elasticities. To illustrate, the model for passenger miles per capita read as follows:

LN (PKM_PC) = Constant + LN (CBDEMPSHARE) + LN (FARE_KM) + LN (FREQUENCY) + LN (COVERAGE) + LN (CARLESS_HH) + LN (UNEMPLOY) + LN (FUEL) + LN (UZADENS_KM)

Findings

The authors find no statistically significant links between the percent of MSA employment in the CBD and transit ridership. The authors find the strongest links between the two service variables (service frequency and service coverage) and transit ridership. Both of these variables are at least partially under the control of transit agency managers. The other consistently significant variable is the percent of MSA households that do not own an automobile. This is an external factor beyond the control of agency managers. The other external factor variables reveal inconsistent relationships across the dependent variables, across time, and across the MSA groups. All the authors' models had high R squared values and large F statistics.

Brown, Jeffrey and Gregory L. Thompson. "The Relationship Between Transit Ridership and Urban Decentralization: Insights from Atlanta." Tallahassee, FL: Florida Planning and Development Lab, Florida State University, 2006.

Focus

Controlling for passenger fare, service levels, and the proportion of transit service provided by rail, this study examines the relationship between transit ridership and the decentralization of population and employment in Atlanta from 1978 to 2003.

Methodology

The authors collected data from the Atlanta Regional Commission, U.S. Bureau of Labor Statistics, U.S. Census Bureau, Metropolitan Atlanta Rapid Transit Authority, and National Transit Database. The following are the key variables:

LPT = annual linked passenger trips

VKM = annual vehicle kilometers of service

PCTRAIL = percent of vehicle kilometers that are railcar miles

FARE = average fare per linked trip (in inflation-adjusted 2005 dollars)

FUEL = an index of motor fuel prices

EMPMARTA = the level of non-CBD employment within the MARTA service area

RATIO_EMP = ratio of employment outside MARTA service area to employment inside MARTA service area (including CBD)

RATIO_POP = ratio of population outside MARTA service area to population inside MARTA service area (including CBD)

OLYMPICS = a dummy variable denoting 1996 as the year of the Atlanta Olympics

The authors used these variables to estimate the following time-series model:

Findings

The authors found that transit ridership is strongly and positively linked to the strength of employment inside the transit agency service area (outside the CBD) and is strongly and negatively linked to the strength of employment of employment beyond the transit agency service area. The authors report no association between the strength of the CBD and transit ridership in Atlanta. The authors note that transit ridership is more strongly linked to the decentralization of employment than to the decentralization of population. Finally, the authors observe that fare levels and the absolute amount of transit service are also associated with transit ridership. The authors rely on their analysis and anecdotal evidence gleaned from interviews with local planners to infer that MARTA is successfully linking transit patrons to dispersed employment locations.

Brown, Jeffrey and Gregory L. Thompson. "Examining the Influence of Multidestination Service Orientation on Transit Service Productivity: A Multivariate Analysis." Tallahassee, FL: Florida Planning and Development Lab, Florida State University, 2006.

Paper Abstract

Between 1990 and 2000, U.S. transit agencies added service and increased ridership, but the ridership increase failed to keep pace with the service increase. The result was a decline in service effectiveness (or productivity). This marks the continuation of a long-running and often-studied trend. The scholarly literature attributes this phenomenon, at least in part, to transit agency decisions to decentralize their service rather than focus on serving the traditional CBD market. Many scholars argue that a decentralized service orientation is both ineffective and inefficient because it attracts few riders and requires large per-rider subsidies. This research tests whether a non-traditional, decentralized service orientation, called multidestination service, results in reduced service productivity. Contrary to what the literature suggests, we find that MSAs whose transit agencies pursued a multidestination service orientation did not experience lower productivity. These results indicate that policies that have encouraged the growth of decentralized transit services have not necessarily been detrimental to the industry.

California Department of Transportation. *An Analysis of Public Transportation to Attract Non-Traditional Riders in California. Sacramento, CA*: California Department of Transportation, 2003.

Focus

The study sought to determine customer expectations and needs regarding transit and to develop strategies to increase transit ridership.

Methodology

The authors used a combination of literature review, a survey of 3,302 California residents, and focus groups to identify expectations and needs. The authors then used geographic information systems (GIS) analysis to identify locations in the state with the best potential to attract riders.

Findings

The authors noted that external factors (land use patterns, parking availability, and aging population) are significant influences on transit ridership and can hinder efforts to increase ridership. The authors observed that both riders and non-riders have similar high expectations about service reliability, convenience, comfort, and safety. They also observed that non-riders are not very likely to commit to using transit even when these high expectations are met. This poses real challenges for agencies seeking to attract more choice riders. The authors identified the state's four largest metropolitan areas as the regions with the highest potential to attract new riders.

Cambridge Systematic, Inc. Transit Ridership Initiative. *Transit Cooperative Research Program Research Results Digest Number 4*. Washington DC: Transportation Research Board, National Research Council, 1995.

Focus

Drawing on interviews with 40 transit agency managers, the authors make observations about the factors that contributed to transit ridership increases between 1991 and 1993.

Methodology

The authors collected and analyzed data on ridership from American Public Transit Association reports to identify candidate systems. The authors then interviewed senior staff at the transit agencies (via telephone) to elicit their comments about the factors they believed accounted for the ridership increases experienced by their agencies.

Findings

Based on their analyses and interviews, the authors assert that external factors, which are those beyond the control of agency managers, typically have a larger effect on ridership than internal factors, which are those within the control of agency managers. The authors identify population changes, regional economic conditions, and development trends as key external factors that affect transit ridership. The authors identify fare policies, service adjustments, and marketing efforts as key internal factors that affect transit ridership. The authors concede that these findings are based on agency staff perceptions of the influences on transit ridership as opposed any statistical analysis of these candidate factors.

Cambridge Systematics, Inc. *Continuing Examination of Successful Transit Ridership Initiatives.* Transit Cooperative Research Program Research Results Digest Number 29. Washington DC: Transportation Research Board, National Research Council, 1998.

Focus

This study is a follow-up to the 1995 "Transit Ridership Initiative" study. The authors conducted follow-up interviews with staff at agencies contacted for the earlier study and added a set of additional agencies for a total of more than 50 transit system managers. The interviews focused on agency ridership experiences from 1994 through 1996.

Methodology

The authors followed the same methodology as in the earlier study to identify additional candidate agencies and interviewed the same agencies they had contacted for the prior study.

Findings

The authors found that the factors identified in the earlier study continued to be commonly cited during the interview process as important determinants of transit ridership.

Cambridge Systematics, Inc. *Evaluation of Recent Ridership Increases*. Transit Cooperative Research Program Research Results Digest Number 69. Washington, DC: Transportation Research Board, National Research Council, 2005.

Focus

This study is the third and final report in a series of studies that identify the key factors and initiatives that led to ridership increases at a set of transit agencies. This report focuses on ridership increases from 2000 to 2002 at 28 agencies.

Methodology

The authors used the American Public Transportation Association's Quarterly Transit Ridership Reports to identify 31 systems with the largest reported ridership increases, including 15 systems that experienced ridership increases from 1994 to 1996 and continued to enjoy ridership increases from 2000 to 2002. The authors then conducted telephone interviews with staff at 28 of the 31 systems.

Findings

The authors found that the most significant ridership increases were the result of a combination of factors or initiatives. The key initiatives fell into five categories: service adjustments, fare and pricing adaptations, marketing and information initiatives, and new efforts in service coordination, collaboration, and partnering. The authors note that most of the 18 systems that experienced the highest ridership growth improved their ability to serve more riders with greater efficiency.

Cervero, Robert. *Ridership Impacts of Transit-Focused Development in California*. Working Paper No. 176, Chapter 2. Berkeley, CA: University of California Transportation Center, 1993.

Focus

The author provides a literature review of several studies that examine the transit ridership characteristics of residential and commercial projects located near rail transit stations.

Methodology

The literature employs surveys of residents and workers in the San Francisco and Washington metropolitan areas.

Findings

A 1991 San Francisco Bay Area study reported no relationship between distance to the transit station and transit mode split for housing located within 1/3 mile of the station. A 1989 San Francisco Bay Area study found that 35 to 40 percent of residents living near three Bay Area Rapid Transit District (BART) stations used public transit.

A 1987 Washington DC study found that rail and bus transit mode share declines by 0.65 percent for every 100-foot increase in distance of a residential site from a rail transit station. The same 1987 study found that ridership was higher at downtown than at suburban work sites and that ridership declined steadily as distance to the station increased.

All these studies essentially examined the correlation between transit mode share and distance to a rail station. They did not control for other factors that might influence an individual's decision to rider transit (fare, service quality, auto access and cost, etc).

Cervero, Robert. 1994. "Making Transit Work in the Suburbs." *Transportation Research Record* 1451 (1994): 3–11.

Paper Abstract

Rapid decentralization of population and employment over the past several decades has chipped away at the U.S. transit industry's market share. The implications of decentralization on the ridership, operating performance, and fiscal health of the nation's largest transit operators are examined. On the basis of the results of a national survey, a number of service strategies that offer hope for reversing transit's decline are explored, including timed transfers, paratransit services, reverse commute and specialized runs, employer-sponsored van pools, and high-occupancy-vehicle and dedicated busway facilities. Land use options, like traditional neighborhood designs and transit-based housing, are also examined. A discussion of various institutional, pricing and organizational considerations when implementing suburban-targeted service reforms and land use initiatives is also provided. Century-old models involving joint public-private development of communities and transit facilities, it is argued, also deserve reconsideration.

Cervero, Robert. *The Transit Metropolis: A Global Inquiry.* Washington DC: Island Press, 1998.

Focus

The author observes that there is a global decline in transit use due to competition with the automobile and continued decentralization of urban areas. However, he notes a dozen metropolitan areas (transit metropolises) that seem to be doing well. The objective of the book is to determine why these cities' transit systems are so successful. His hypothesis is that they have matched their transit services with their land use patterns.

Methodology

The book is a series of case studies. The author classifies the cities into four categories: 1) adaptive cities (cities using rail transit to guide urban growth, which include: Stockholm-rail-served satellite cities; Copenhagen-suburban communities along radial rail lines; Tokyo-new towns served by rail transit; Singapore-strong land use and transport planning); 2) hybrid cities (cities that are tailoring transit to serve their urban forms and adapting urban form using transit: Munich-leveraging existing pro-transit development patterns; Ottawa-strong use of busway; Curitiba-linear city oriented around bus rapid transit); 3) strong core cities (cities that integrate transit with strong centralized development patterns: Zurich-auto restraint plus pro-transit policies; Melbourne-using transit to encourage centralized urban pattern); and 4) adaptive transit (cities that adapt transit to serve decentralized urban form: Karlsruhe, Germany-use of adaptive light rail transit; Adelaide, Australia-use of bus ways; Mexico City-hierarchy of transit services). The author then gathers quantitative and qualitative data to paint a portrait of the city and its use of transit. All the cases are success stories.

Findings

The author offers fifteen lessons: 1) transit metropolises evolve from a well-articulated vision of the future; 2)transit metropolises need inspired leadership; 3) they need efficient institutional structures (especially at regional level); 4) they need pro-active planning processes; 5) they need to maintain strong, viable CBDs; 6) they need balanced traffic flows; 7) the transit agencies need to have an ethos of competition to provide efficient, low-cost service; 8) they need to give transit priority over the automobile; 9) they take incremental steps; 10) they have people-friendly urban design; 11) they have policies to restrain automobile ownership and use; 12) they have integrated transit services; 13) they have flexible transit services-give a strong role for buses; 14) they embrace innovation in service delivery; and 15) they take advantage of serendipitous developments. The author closes by briefly discussing five North American cities that he sees as following in the footsteps of the transit metropolises: Portland, Oregon; Vancouver, British Columbia; San Diego, California; St. Louis, Missouri; and Houston, Texas.

Cervero, Robert. "Walk-and-Ride: Factors Influencing Pedestrian Access to Transit." *Journal of Public Transportation* 3, no. 4 (2000): 1–23.

Paper Abstract

The predominant means of reaching suburban rail stations in the United States is by private car. Transit villages strive, among other things, to convert larger shares of rail access trips to walk-and-ride, bike-and-ride, and bus-and-ride. Empirical evidence on how built environments influence walk-access to rail transit remains sketchy. In this article, analyses are carried out at two resolutions to address this question. Aggregate data from the San Francisco Bay Area reveal compact, mixed-use settings with minimal obstructions are conducive to walk-and-ride rail patronage. A disaggregate-level analysis of access trips to Washington Metrorail services by residents of Montgomery County, Maryland, shows that urban design, and particularly sidewalk provisions and street dimensions, significantly influence whether someone reaches a rail stop by foot or not. Elasticities are presented that summarize findings. The article concludes that conversion of park-and-ride lots to transit-oriented developments holds considerable promise for promoting walk-and-ride transit usage in years to come.

Cervero, Robert. "Built Environment and Mode Choice: Toward a Normative Framework." *Transportation Research Part D* 7, no. 4 (2002): 262–284.

Focus

The author examines the effect of built environment variables measuring density, diversity, and design, as well as generalized modal cost and socioeconomic variables, on individual mode choice in Montgomery County, Maryland.

Methodology

The author obtains trip data from the 1994 Household Travel Survey compiled for the Metropolitan Washington Council of Government and both travel time and land use data from databases compiled for use in area travel forecasting models. The author then estimates probabilistic models for a trip being made by each of three modes of transportation (solo auto, group-ride auto, and transit) as a function of a vector of land use variables and utility functions associated with making a trip from point A to point B using that mode of travel.

Findings

The author finds that land use density and diversity have moderate, inelastic (in the .2 to .6 range) effects on transit ridership. The authors note that design variables have more modest, yet measurable, effects on transit use.

Cervero, Robert. "Office Development, Rail Transit, and Commuting Choices." *Journal of Public Transportation* 9, no. 5 (2006): 41–55.

Focus

The article examines commuting behavior in workplace environments served by rail transit.

Methodology

The author compiles information from a number of his empirical studies that explored differences in transit mode share in different kinds of work place environments.

Findings

The author finds that people working in office buildings near rail transit are three times more likely to use transit than those working further away from rail transit stations. The author argues that the presence of feeder bus services, employer transit subsidies, and scarce parking are all key factors influencing the mode choice decision. The author advises policymakers to promote the use of feeder buses, employer-based transit subsidies, and flexible parking policies in these near-station work environments.

Cervero Robert. "Transit-oriented development's ridership bonus: a product of self-selection and public policies" *Environment and Planning* A 39(9) (2007): 2068–2085

Focus

The author examines what he terms the "ridership bonus"among people living near California rail stations in California by comparing their behavior to people who live beyond comfortable walking distance of the stations.

Methodology

The author used a database on travel behavior and other attributes of 1000 people living in 26 housing projects within ½ mile of urban rail stations in California. He estimated binomial logit models for predicting transit mode choice for residents' commute trips as a function of travel times, regional accessibility, workplace job and parking policies, neighborhood design, auto ownership levels, and a variable measuring transit lifestyle preference. He also estimated a binomial logit model predicting non-motorized access to rail stations as a function of income, ownership, and the density of street lighting. Finally, he estimated a pair of nested logit models for location choice and mode choice as a function of an array of location, transportation, household, neighborhood, and individual attributes.

Findings

The author finds that residential self-selection (lifestyle preference), employer-based parking policies, and destination-area street connectivity are among the key factors that influence residents' decision to ride transit. The author calls for an array of regulatory (zoning) and market-based strategies to take advantage of these findings and promote more "transit-based" housing.

Cervero, Robert and John Beutler. *Adaptive Transit: Enhancing Suburban Transit Services*. Berkeley, CA: University of California Transportation Center, 1993.

Focus

The authors set out to identify places where transit agencies have implemented services that have allowed them to adapt to the changing population and employment patterns of their metropolitan areas. The authors emphasize the use of seamless services that avoid transferring. They distinguish between three types of adaptive services: technological innovations, bus-based service innovations, and small-vehicle Paratransit services.

Methodology

The authors identified ten case studies (including cases in the United States, Canada, Australia, Germany, and Puerto Rico) that involved the use of some form of adaptive service. The authors caution that many of the cases have yet to yield data that would permit a detailed effectiveness evaluation.

Findings

The authors do not attempt to develop overall lessons, but rely on their individual case studies to provide insights to policymakers and transit managers (the authors' intended audiences). Among the more promising services identified here were bus rapid transit (then a not widely discussed phenomenon) and free-market Paratransit services. Interestingly, the authors do not investigate the importance of integrating bus with rail transit, although they include both bus and rail case studies.

Charles River Associates, Inc. *Building Transit Ridership: An Exploration of Transit's Market Share and the Public Policies that Influence It.* Transit Cooperative Research Program Report 27. Washington DC: Transportation Research Board, National Research Council, 1997.

Focus

The report discusses strategies that have been used to help increase public transit ridership and travel market share.

Methodology

The authors conducted a survey of 50 transit agencies in the United States and Canada, detailed case studies of eight agencies, and a general analysis of the state of the transit industry. The authors had hoped to conduct a quantitative analysis but were unable to do so because of insufficient data and resources.

Findings

The authors found that ridership growth has not been a priority for the surveyed agencies; they have been focused more on serving existing customers. The survey also found that transit-related initiatives alone were not sufficient to shift significant numbers of people from the automobile. The report followed the survey with a more detailed investigation of eight case study sites. These included: feeder bus (Metro North), fare integration (Toronto), Express bus (Minneapolis), times transfer (Norfolk), U Pass (Seattle), fareless square (Portland), land use (Toronto), and road pricing. The experiences were judged positive in the cases of Metro North, Toronto, and Seattle. Flat ridership results were reported in Portland. The other cases lacked sufficient data to make a definitive judgment. The authors conclude by noting that policies that make private vehicle use less attractive will have a larger positive effect on ridership than policies that make transit more attractive.

Chung, Kyusuk. "Estimating the Effects of Employment, Development Level, and Parking Availability on CTA Rapid Transit Ridership from 1976 to 1995 in Chicago." Paper presented at the 1997 Metropolitan Conference on Public Transportation Research, 1997.

Focus

The author examines the effects of employment, CBD office occupancy rates, and parking on rail transit ridership in Chicago when controlling for fare.

Methodology

The author estimated a multivariate model incorporating variables measuring the above factors. The ordinary least squares regression model had an R-squared of 0.90, indicating that variation in these explanatory variables accounted for 90 percent of the variability in rail transit ridership over the 1976 to 1995 study period.

Findings

The study yielded a strong model, as noted above, but there are also some important caveats. First, the employment and office occupancy variables are undoubtedly correlated with one another, which would influence the model results. Second, the model uses a total employment variable as opposed to an employment distribution variable. Total employment tends to be correlated with population, which tends to be correlated with a number of other variables not included in the model. Thus, it is unclear whether employment itself is a strong influence or one of the hidden correlates of employment. Finally, the model only estimates rail transit ridership, as opposed to total transit ridership. The implications for overall transit ridership are not clear.

Dueker, Kenneth, James Strathman, and Martha J. Bianco. *Strategies to Attract Auto Users to Public Transportation.* Transit Cooperative Research Program Report 40. Washington DC: Transportation Research Board, National Research Council, 1998.

Focus

This report examines the effectiveness of automobile parking policies, alone and in conjunction with changes to transit service policy, in attracting automobile users to public transportation.

Methodology

The authors employed a literature review followed by statistical modeling (based on the 1990 NPTS) of likely effects of policy changes, and then conducted an extensive set of case study interviews to capture locations where one or more of eight defined parking policies had been employed. The authors collected information about the specific parking policy and its implementation, transit service changes, other public policy interventions, transit ridership, and the general socio-economic and land use profile of the case study sites.

Findings

The authors found strong relationships between parking prices and transit use.

Elmore-Yalch, Rebecca. *Using Market Segmentation to Increase Transit Ridership.* Transit Cooperative Research Program Report 36. Washington DC: Transportation Research Board, National Research Council, 1998.

Focus

This document is a guidebook that covers issues, procedures, and strategies associated with the use of market segmentation to tailor ridership initiatives to particular markets of transit customers.

Methodology

The guidebook discusses the application of market segmentation strategies in Boise, Milwaukee, and Washington DC. The discussion does not contain data that would allow one to directly connect the strategy to increased ridership.

Findings

The guidebook is simply designed to introduce agency managers to market segmentation concepts and their application.

Evans, John. *Transit Scheduling and Frequency.* Transit Cooperative Research Program Report 95, Chapter 9. Washington DC: Transportation Research Board, National Research Council, 2004.

Focus

This chapter is part of a larger study of traveler responses to transportation system changes. This chapter examines changes to transit schedules and frequencies. It does not examine changes to transit service structures.

Methodology

The authors recount the results of a series of studies dating from the 1960s to 2000s on different service schedule and/or frequency changes and the ridership results. The authors use this information to calculate the elasticity of ridership with respect to the particular service change.

Findings

The author found that ridership does respond to service frequency or schedule changes (elasticity = 0.5), and that the largest responses are found in higher income areas that previously had very infrequent service. In more traditional transit areas, the ridership response was more modest. The author use the results of rider surveys to note that between one half and one third of the new transit riders would have previously driven cars to make their trip.

Ferreri, Michael. "Comparative Costs." In *Public Transportation*, edited by G.E. Gray and L.A. Hoel. 2nd ed. Englewood Cliffs, NJ: Prentice Hall, 1992.

Synopsis

This chapter in the Gray and Hoel text discusses the various components of operating and capital transit costs. Its usefulness for our study is in its assertions that transit is best suited to serving the CBD and other traditional transit markets. The chapter attributes the decline in transit service productivity to decentralizing urban forms and the dispersion of activities throughout the urban area. It notes that transit has a particularly difficult time effectively serving this kind of urban environment. The chapter is therefore reflective of the traditional view in the literature.

Frumkin-Rosengaus, Michelle. *Increasing Transit Ridership through a Targeted Transit Marketing Approach*. University Microfilms International, 1987.

Focus

This dissertation concentrates on commuters as the target market segment, analyzing their response to transit marketing at the place of employment.

Methodology

This dissertation tested two marketing theories. The first is a Peer Pressure Theory proposing that it is more effective for a marketing campaign to target areas of existing high ridership. The second is a Utilitarian Theory suggesting that marketing campaigns will have an effect regardless of the area's previous ridership trends. Santa Clara County Transit was used as the case study. The major employment centers used for the analysis were Varian, Lockheed and several companies located within Moffett Park. Information was obtained for 545 transit riders.

Findings

After nine months of marketing campaigns, 21 percent of the transit riders were new riders and 79 percent were riders who were utilizing the transit service before the marketing efforts began. Several multivariate statistical techniques were used to analyze the data. A correlation analysis showed a positive, though small, correlation between the residential areas of new riders and old riders. A principal components analysis indicated that 88 percent of the variation of new riders could be explained with fourteen variables combined into three components. A multiple regression analysis showed that new riders could be predicted with a standard error of 1.6, yielding a multiple correlation coefficient of 0.8 between the number of predicted and observed new riders. The research findings indicate that the response to transit marketing is, in fact, related to a peer pressure effect and to the diffusion of information, but there were other important factors as well. A long distance from place of residence to place of employment, in terms of commute time, was a key variable. High ridership areas were also characterized by a concentration of high household incomes, a predominance of white collar workers and the existence of a conveniently located park-and-ride lot.

Gomez-Ibanez, Jose A. "Big-City Transit Ridership, Deficits, and Politics: Avoiding Reality in Boston." *Journal of the American Planning Association* 62, no. 1 (1996): 30–50.

Focus

The author examines changes in ridership and agency deficits for the Massachusetts Bay Transportation Authority in Boston from 1970–1990. He employs a multivariate statistical analysis that tests the effects of internal factors (fare and service policies) and external factors (per capita income and employment in the city of Boston) on ridership levels.

Methodology

The author obtained data for the time period 1970 to 1990. The author estimated multivariate models that include the following variables:

Income = Real per capitaper capita income for the MSA (in log form)

Employment = Jobs in the city of Boston (in log form)

Fare = Real average fare per passenger trip (in log form, one-year lag)

Vehicle miles = Vehicle miles of service operated by MBTA (in log form, one-year lag)

Dummy variable for 1980-1981 = Dummy for year in which MBTA service was reduced considerably

In one multivariate model, the author substituted a trend variable for the income variable, with marginal effects on either model performance or the significance levels and elasticities associated with the explanatory variables.

Findings

The author found: 1) a 1 percent decline in the percent of jobs in the city of Boston was associated with between a 1.24 percent and 1.75 percent decline in ridership; 2) a one percent increase in real per capita incomes was associated with a 0.71 percent decline in ridership; 3) a one percent increase in fares was associated with a .22 to .23 percent decline in ridership; and 4) a one percent increase in vehicle miles of service was associated with a .30 to .36 percent increase in ridership. The authors' models accounted for nearly 90 percent of the variation in MBTA ridership from 1970–1990. Durbin-Watson statistics indicate that the models are appropriately specified.

The author uses the model results to state that transit ridership in Boston has been strongly influenced by factors beyond the agency's control (particularly the decentralization of employment). However, the definition of employment is problematic and measures jobs throughout the city of Boston as opposed to jobs inside the central business districts of Boston and Cambridge, which the author had hoped to measure. The authors findings are considerably different from those obtained by Brown and Thompson (2006) for Atlanta, but there are considerable differences in the definition and treatment of employment in these studies.

Haas, Peter. "Ridership Enhancement Quick Study." Mineta Transportation Institute, San José State University, 2005.

Focus

The author identifies and discusses the specific characteristics or factors that might lead an agency to adopt one or more of four strategies (ECO pass programs, guaranteed ride home programs, day passes, and online fare media sales programs) that are frequently cited as effective ways to boost ridership. The author focuses on the 150 largest transit agencies in the United States.

Methodology

The author used a preliminary search of agency websites to identify agencies that use these strategies and then conducted interviews with managers at each of the agencies.

Findings

The author identified a number of service, urban structure, and travel characteristics that seem to act as barriers to the introduction of these strategies (low density, system size, service hours, etc). The author then identified a number of agencies that he believes represent likely candidates for the successful introduction and adoption of these strategies.

Hadj-Chikh, Gibran J. and Gregory L. Thompson. "Reaching Jobs in the Suburbs: Tri-Rail in South Florida." *Transportation Research Record* 1618 (1998): 14–21.

Focus

The authors examine traffic patterns on the Tri-Rail commuter rail system in south Florida. The station siting process led to the construction of some stations that seemed well-suited to serving suburban transit markets as opposed to the central business district-bound market. The authors compare the degree to which people are using the service to reach suburban destinations versus the central business district.

Methodology

The authors gathered ridership data from Tri-Rail staff. These data provided ridership between all pairs of stations (from automated ticket machines) for one work week during a 12-hour period (4 a.m. to 4 p.m.). The authors classified station pairs as serving the suburb-to-suburb or suburb-to-CBD market. They made comparisons between the two markets for six distance categories.

The authors evaluated three hypotheses. The first hypothesis tested whether suburban jobs could support commuter rail to the same degree as CBD jobs. They estimated a gravity model as part of the process of testing this hypothesis. The second hypothesis tested the ability of stations to serve their potential market. They estimated an index of market penetration to evaluate this hypothesis. The third hypothesis tested whether the degree of market penetration of a station pair was related to the distance between the stations. They estimated a multivariate model to evaluate this hypothesis.

Findings

The authors find that both markets have comparable total potential ridership. They identify potential ridership all along the Tri-Rail corridor, not just where the CBD is the destination. The authors found that Tri-Rail penetrates the suburb-to-CBD market about twice as much as the average suburb-to-suburb market. The authors also found that market penetration increased with distance, although the model left a considerable amount of unexplained variation in the dependent variable.

The authors use the results to highlight the existence of sizeable suburb-to-suburb demand for commuter rail service. They further observe that commuter rail planners who are developing their systems to serve CBD markets might be able to tap this potential market at very little additional cost.

Hemily, Brendon. *Trends Affecting Public Transit's Effectiveness: A Review and Proposed Actions*. Washington DC: American Public Transportation Association, 2004.

Focus

The author reviews a wide range of data, including socio-economic trends, changes in land use and mobility patterns, societal changes, and emerging professional practices to distill the "challenges they create for transit system effectiveness and for the industry as a whole, and to identify some questions, opportunities, and potential actions for consideration in the formulation of future strategic directions for transit in the community" (vii).

Methodology

The author compiles literature and data from a wide range of sources to paint a portrait of the continuing evolution of communities and the implications these continuing changes to patterns of residential location, employment location, and mobility desires and needs have for the transit industry.

Findings

The author uses the review to identify a new vision for transit's role in the community. This vision is "[a] transportation system that meets the needs for mobility and accessibility while balancing the current and long-term goals of economic growth, environmental quality, and social equity" (viii). The author identifies three key actions that should be pursued to achieve the vision: provision of new transit infrastructure, a focus at all levels of government on smart growth and sustainable land use planning, and more use of market segmentation strategies that are designed to tailor transit services to the specific needs of different rider groups.

Hendrickson, Chris. "A Note on Trends in Transit Commuting in the United States Relating to Employment in the Central Business District." *Transportation Research Part A* 20, no. 1 (1986): 33–37.

Focus

The author uses basic statistical analysis to examine the link between public transit ridership and number of jobs in the central business district in 1970 and 1980, and the change between 1970 and 1980. The author uses transit commute mode share as the measure of ridership. The sample consists of 25 large metropolitan areas in the U.S.

Methodology

The author gathers data from the US Census Bureau to estimate a series of multivariate models. The first multivariate model estimates ridership in 1970 as a function of CBD employment in 1970 (R square = .96), the second model estimates ridership in 1980 as a function of CBD employment in 1980 (R square = .90), and the third model estimates ridership in 1970 as a function of both CBD employment and the total number of workers in the metropolitan area (R square = .98). The author then estimates two change models, one with a dummy variable for Sunbelt cities (R square =.77) and one without (R square = .66). Finally, he estimates a change model including dummy variables for both Sunbelt cities and those with fixed rail systems (R square = .81).

Findings

The author finds strong relationships between CBD employment and transit commute mode share. The author finds positive, statistically significant effects on transit commute mode share from the Sunbelt dummy variable, and negative, statistically significant effects from the fixed-rail dummy variable.

The study's shortcomings include: 1) the lack of control variables and 2) the mixing of cities with significant differences in both the size of the CBD and the transit commute mode share. Particularly problematic is the inclusion of New York, which dwarfs the other cities on both variables, in the data set.

Institute of Urban and Regional Development, Parsons Brinckerhoff Quade and Douglas, Inc., *Bay Area Economics, and Urban land Institute. Transit-Oriented Development in the United States: Experiences, Challenges, and Prospects*. Transit Cooperative Research Program Report 102, Chapter 8. Washington DC: Transportation Research Board, National Research Council, 2004.

Focus

This chapter from a TCRP report on transit-oriented development examines evidence about the ridership effects.

Methodology

The authors query an extensive literature that examines transit ridership at both residential and employment-related land uses that meet the characteristics of transit-oriented development.

Findings

The authors report the descriptive results of residential studies showing that: 1) workers living near BART were six times more likely to use it for commute trips than the average Bay Area resident; 2) workers living near light rail transit in Silicon Valley were five times more likely to use transit for commute trips than average area residents; and 3) people living near transit in Washington DC have high transit mode shares that decline with increased distance from a transit station. The authors also summarize a set of office and retail studies that showed: 1) 50 percent of those working within 1,000 feet of a downtown Washington Metro station used rail to get to work; 2) 60 percent of customers at a downtown San Diego shopping center located two blocks from light rail arrived either by transit or by foot; and 3) 34 percent of patrons at a downtown San Francisco shopping center that has a direct connection to BART arrived by transit.

The authors also present a set of multivariate models from studies for the San Francisco Bay Area and Arlington County, Virginia that indicate particularly strong relationships between the density of the land use and transit ridership. Overall, the authors conclude that residents living in transit-oriented developments usually patronize transit five to six times as often as the typical resident of a region. The authors acknowledge that self-selection bias might be an issue in the residential studies they discuss.

Jones, David. *Urban Transit Policy: An Economic and Political History.* Englewood Cliffs, NJ: Prentice-Hall, 1985.

Synopsis

Jones' book is an account of the past several decades of public transit history. He focuses a great deal of attention on the loss of most transit markets to the automobile during the period from the 1920s to the 1950s and its shrinking to focus primarily on the CBD-bound commuter and transit dependent riders.

Kain, John. "Cost-Effective Alternatives to Atlanta's Rail Rapid Transit System." *Journal of Transport Economics and Policy* (January 1997): 25–49.

Focus

The article examines the policy history of rail transit in Atlanta, estimates a multivariate time-series model to explain ridership change from 1972 to 1993, and uses the estimated model to examine the likely performance of alternatives to rail rapid transit development.

Methodology

The paper estimates multivariate time series models that predict ridership as a function of fares, service miles, vehicle size, fuel prices, regional employment, and a trend variable that functions as a proxy for decentralization. Most of the variables are inserted in the model in their natural log forms.

Findings

The models indicate that ridership was strongly influenced by fares, service, vehicle size, and fuel prices. The trend variable also proved statistically significant, although the elasticity is quite small. Brown and Thompson (2006) present a model that extends Kain's work and incorporates more direct measures of population and employment decentralization.

Kain, John F. and Zhi Liu. "Secrets of Success: Assessing the Large Increases in Transit Ridership Achieved by Houston and San Diego Transit Providers." *Transportation Research Part A* 33, nos. 7/8 (1999): 601–624.

Focus

The authors examine the experiences of transit systems in Houston and San Diego that achieved large ridership increases during a period when transit systems in most other metropolitan areas experienced large ridership declines. They develop a series of multivariate models that seek to explain variation the variation in ridership over time as a function of fares, service, automobile variables, per capita income, and regional employment variables.

Methodology

The authors estimate time-series models to explain variation in ridership from year-to-year, and then use the model estimates to investigate the likely ridership effects of different fare and service strategies. The authors discovered that the variables most strongly connected to ridership are service levels, fare levels, and metropolitan employment and population growth. This study is an update of a study the authors conducted in 1995 for the Federal Transit Administration.

Findings

The authors used their models to develop estimates of operating and total costs per passenger boarding and per passenger mile for Houston's bus transit system and San Diego's bus and light rail transit operators. These estimates suggest that the bus systems are more cost-effective than the light rail systems when evaluated on the basis of total costs per passenger.

Kohn, Harold M. "Factors Affecting Urban Transit Ridership." Paper presented at the Canadian Transportation Research Forum Conference, 2000.

Focus

The author uses a study of 85 Canadian transit companies to determine the importance of fares, population size, and service variables as predictors of transit ridership.

Methodology

The author collects data for 85 transit agencies covering the period 1992 to 1998. He then tests alternate multivariate models to arrive at the best model to predict transit ridership.

Findings

The author finds that the best predictors of transit ridership (R square = 0.97, F = 7190) are average fare and vehicle revenue hours. The author leaves unexamined many external factors (urban density, urban area size, socioeconomic characteristics) that might be associated with both of his explanatory variables.

Kuby, Michael, Anthony Barranda, and Christopher Upchurch. "Factors Influencing Light-Rail Station Boardings in the United States." *Transportation Research Part A* 38 (2004): 223–247.

Focus

The authors analyze light rail station boardings at 268 stations in nine US metropolitan areas in order to identify the factors that influence the number of LRT boardings. Their study updates a 1996 study by Parsons Brinckerhoff Quade and Douglas.

Methodology

The authors obtained station-based weekday boarding data for the year 2000 for 268 light-rail transit stations in Baltimore, Buffalo, Cleveland, Dallas, Portland, Sacramento, Saint Louis, Salt Lake City, and San Diego. They collected five types of independent variables. The variables fall into five categories. Traffic generation/land use variables include employment within walking distance of station, population within walking distance, an airport dummy variable for airport stations, an international border dummy variable, a CBD dummy variable, and college enrollments, if there is a college within walking distance. Intermodal access variables include number of park-and-ride spaces, number of bus line connections, and a dummy variable for other rail line connections. Citywide variables include monthly heating and cooling degree days (i.e. number of days deviating from a 65 degree F base temperature), PMSA population, and dummy variables for each city. Network structure variables include a terminal station dummy variable, station spacing, a dummy variable for designated transfer stations, average total travel time to all other stations (an accessibility measure), and percentage of PMSA employment within walking distance. The socioeconomic variable included the percent renters within walking distance. The authors uses an OLS multiple regression model, after testing and correcting for multicollinearity among variables.

Findings

The authors' final model explained 73 percent of the variance in weekday boardings. The employment in station area, population in station area, border, park and ride, bus connection, degree days, terminal, transfer, centrality, and percent renters variables were all significant, with signs in the hypothesized directions. These are a few of the highlights. The CBD dummy variable is not significant. The centrality variable indicates the importance of reducing travel times when planning a system's number of stations. The more population or employment within walking distance, the higher the boardings. The more extreme temperatures, the lower the ridership. The higher the number of bus connections and/or park and ride spaces the higher the boardings. The strongest variable is the dummy variable denoting the presence of the international border, which is near the San Ysidro station in San Diego.

Kuzmyak, J. Richard, Richard Pratt, G. Bruce Douglas, and Frank Spielberg. *Land Use and Site Design.* Transit Cooperative Research Program Report 95, Chapter 15. Washington, DC: Transportation Research Board, National Research Council, 2003.

Focus

This chapter is part of a larger study of traveler responses to transportation system changes. This chapter examines traveler responses to various dimensions of land use and site design.

Methodology

The report presents a compilation of empirical studies on the topic.

Findings

The authors report that transit ridership tends to be higher at higher densities. Citing work by Parsons Brinckerhoff, et al (1996) for Chicago, they report that a 10 percent increase in residential density is correlated with an 11 percent increase in per capita transit trips and a 13 percent increase in transit mode share. Citing work by Levinson and Kumar for a national study of the U.S., the authors report that density only becomes relevant to mode choice at densities higher than 7,500 persons per square mile. Citing work by Frank and Pivo (1994) in Seattle, the authors note that transit requires workplace densities of 50–75 employees per gross acre and residential densities of 10–15 dwelling unit per net residential acre to achieve significant commute mode shifts. Citing a study by Nelson/Nygaard (1995) for Portland, Oregon, the authors note that housing density and employment density accounted for 93 percent of the variation in daily transit trip productions and attractions across the region.

The authors also present the results of studies indicating that transit use tends to be higher in areas characterized by mixed land uses. However, the authors caution that many of these environments tend to also be characterized by higher densities, so separating the mixed use effect from the density effect is difficult. Citing work by Messenger and Ewing (1996) in Florida, the authors note that more balanced (jobs and workers) areas tend to have higher transit mode share. Citing a study by Cervero (1989) for 57 suburban activity centers, the authors note that centers with onsite housing had 3 to 5 percent more transit, bike, and walk trips.

Finally, in terms of the influence of site design, the authors note that in more transit and pedestrian friendly environments transit use tends to be higher. The authors cite studies by Cervero (1988, 1989, 1991), Cambridge Systematics (1994), Comsis (1994), and Hooper (1989) that show modestly higher transit mode shares in areas that are characterized by a more pedestrian and transit friendly environment. However, many of these environments also tend to possess higher densities and mixed uses, so isolating the effects of design can be difficult.

The authors caution that in many of these studies self-selection bias may be a concern, particularly in studies of residential uses.

Kyte, Michael. *Measuring Change in Public Transportation Usage: an Analysis of the Factors Influencing Transit.* University Microfilms International, 1986.

Focus

The focus of this research is the development of a methodology for analyzing changes in public transportation usage over time.

Methodology

The methodology includes three elements: (1) the development of a set of models that relate transit demand to level of service, cost, and market size, (2) assessment of the impacts of past service and fare changes, and (3) forecasting the effects of future service and fare changes on transit ridership. The statistical methodology used here is the time-series analysis and modeling approach of Box and Jenkins. This methodology was applied to data describing transit usage in Portland, Oregon from 1971 through 1982. Three levels of data aggregation were used: system level, sector level, and route level. Five different classes of time-series models were developed.

Findings

The following conclusions can be drawn from this research: (1) Service level, cost, and market size adequately explained both past and future variations in transit ridership. The effects of service level and fare changes on transit ridership are not instantaneous but are delayed and distributed over specific periods of time. (2) The models were consistent, in terms of lag structure and elasticities, among the three data aggregation levels. (3) Impact analysis using intervention models provided an assessment of nine systemwide events and 78 individual route level service changes. This research represents an important extension of previous work in this area. The use of three different aggregations of data has yielded important perspectives on the relative effectiveness of system vs. route level models. Lag structures have been more clearly identified here than in any previous study. In addition, the study of all service and fare changes implemented in Portland between 1971 and 1982 has provided important information on how elasticities can vary over time and according to the specific situation of a given change.

Levinson, Herbert, Samuel Zimmerman, Jennifer Clinger, Scott Rutherford, Rodney L. Smith, John Cracknell, and Richard Soberman. *Bus Rapid Transit.* Transit Cooperative Research Program Report 90. Washington DC: Transportation Research Board, National Research Council, 2003.

Focus

The authors review the literature to develop guidance for transit agencies that are considering the development of Bus Rapid Transit.

Methodology

The authors review the emerging literature on Bus Rapid Transit (BRT) to define the BRT concept, discuss key design and operational features of BRT, identify BRT benefits, identify and value BRT costs, and provide general lessons learned from a survey of 26 BRT Case study sites scattered around the world. These case studies are discussed on a companion CD-ROM.

Findings

Generally, the authors find that BRT can be a very successful, low-cost strategy to gain ridership, as its supporters claim. Systems that have implemented BRT have enjoyed ridership increases above and beyond the number of riders who were using transit service prior to BRT implementation. There is no consideration of other factors that might influence the ridership trends.

Litman, Todd. "Rail Transit Impacts on Transportation System Performance." Paper presented at the 2004 Annual Meeting of the Transportation Research Board, 2004.

Synopsis (Excerpted from Abstract)

This paper evaluates rail transit benefits based on a comprehensive analysis of transportation system performance in major U.S. cities. It finds that cities with large, well established rail systems have significantly higher per capita transit ridership, lower average per capita vehicle ownership and annual mileage, less traffic congestion, lower traffic death rates, lower consumer expenditures on transportation, and higher transit service cost recovery than otherwise comparable cities with less or no rail transit service. This indicates that rail transit systems provide economic, social and environmental benefits, and these benefits tend to increase as a system expands and matures.

Liu, Zhi. *Determinants of Public Transit Ridership: Analysis of Post-World War II Trends and Evaluation of Alternative Networks.* Cambridge, MA: Harvard University, 1993.

Focus

The author estimates a series of multivariate models to explain transit ridership in Portland, Oregon between 1950 and 1990.

Methodology

The author estimates multivariate models that predict transit ridership (trips per capita) as a function of passenger car registrations, per capita transit subsidies, percent of population in the central city, city population, gasoline price, passenger fare, MSA employment, transit vehicle miles of service, and a time trend variable. Variables are entered in their log forms.

Findings

The author's key finding is that income, passenger car registrations, and central city population all have strong effects on ridership. The automobile variable is problematic, however, in that the total number of vehicle registrations variable does not tell us anything about the level of household vehicle ownership, in particular the number of households that do not own an automobile. This variable has been found to be a strong predictor of transit ridership. The author uses insights from the analysis to predict the likely ridership results of individual variable trends on ridership.

Lund, Hollie and Richard W. Willson. *The Pasadena Gold Line: Development Strategies, Location Decisions, and Travel Characteristics along a New Rail Line in the Los Angeles Region*. Mineta Transportation Institute, San Jose State University, 2005.

Focus

The authors examine travel behavior, attitudes, and other individual characteristics at transit-oriented residential developments along the Gold Line light rail transit line in Los Angeles. The authors observe a boom in transit-oriented development activity but lower than expected ridership (one half of forecast).

Methodology

The authors survey all residents in 37 multifamily buildings located within 1/3 mile of rail stations. Of 1,595 housing units surveyed, they obtained responses from 221 units recording information about 477 trips. The authors interviewed ten developers and five property managers. The authors gathered neighborhood population and housing profile data from the U.S. Census Bureau. The authors also conducted site visits to assess the local pedestrian environment.

Findings

The authors found few transit-dependent residents in their survey. Respondents were primarily white, worked in professional occupations, and owned one or more automobiles. Few residents had low incomes. About 75 percent of respondents rarely or never used transit, while 15 percent regularly used transit. The authors noted that respondents were more frequent transit users after they moved to their current place of residence, but noted that there might be a self-selection bias at work.

The interviews with developers and property managers elicited a widespread sense that having their property near the transit line led to a rent and/or market value premium. However, there is also significant demand for housing in these communities, so the effect of location cannot be isolated from these larger market forces.

McCollom, Brian and Richard Pratt. *Transit Pricing and Fares.* Transit Cooperative Research Program Report 95, Chapter 12. Washington DC: Transportation Research Board, National Research Council, 2004.

Focus

This chapter is part of a larger study of traveler responses to transportation system changes. This chapter examines changes to pricing and fares.

Methodology

The authors present the results of a series of studies dating from the 1960s to 2000s on different pricing and/or fare changes and the ridership results. The authors use this information to calculate the elasticity of ridership with respect to fare.

Findings

The authors noted that while fare elasticities are inelastic, ridership is sensitive to fares. For bus transit, the authors report elasticities at around -0.4 and for rail transit they report elasticities at around -0.18. They found that riders are more sensitive to off-peak fares than to peak period fares, and that elasticities decrease as the size of the city increases. They found that innovative pricing programs like unlimited-use passes and pre-paid cards typically led to ridership increases.

McLeod, Malcolm, Kevin Flannelly, Laura Flannelly, and Robert Behnke. "Multivariate Time-Series Model of Transit Ridership Based on Historical, Aggregate Data: The Past, Present, and Future of Honolulu." *Transportation Research Record* 1297 (1991): 76–84.

Focus

The authors estimate multivariate models to determine the principal influences on transit ridership in Honolulu between 1956 and 1984.

Methodology

The authors develop a multivariate model that predicts transit ridership (revenue trips) as a function of the number of civilian jobs, per capita income, fare, the number of buses, and a dummy variable identifying years in which a strike occurred. All but the last variable are transformed into their natural log forms. The authors then estimated a similar model that substituted linked passenger trips as the dependent variable.

Findings

The multivariate models explained more than 97 percent of the variation in transit ridership over the study period. However, there are some cautions. The income variable is at best an imperfect gauge of either overall regional economic activity or individual household welfare. The service variable (number of buses) is not the most desirable means of tracking service per capita—more appropriate would be to use vehicle hours or vehicle miles.

Meyer, John and Jose Gomez-Ibanez. *Autos, Transit, and Cities*. Cambridge, MA: Harvard University Press, 1981.

Synopsis

The authors argue that political decisions have resulted in the redistribution of transit service from core areas to low-density suburbs. The consequence has been a decline in service productivity, as measured on a cost per unit of service basis. The authors attribute these political decisions to a combination of a desire to broaden the political base for mass transportation subsidies and a sincere belief in the social benefits of these services. The authors' work is typical of a large body of literature calling for privatization as the only way to avoid these kinds of policy decisions.

Meyer, John, John F. Kain, and Martin Wohl. *The Urban Transportation Problem*. Cambridge, MA: Harvard University Press, 1965.

Synopsis

In this classic work, the authors document decentralization of various populations in all sizes of metropolitan areas in the United States over the course of several decades. They also document the declining importance of transit in urban regions and attribute the decline to decentralization. They argue that transit performs best where it links high density suburbs to large and dense central business districts, both of which are environments that are in relative decline in almost all metropolitan areas. The authors do not address the question of whether fixed route transit can serve other types of markets but implicitly assume that it cannot.

Mieger, David and Chaushie Chu. "The Los Angles Metro Green Line: Why Are People Riding the Line to Nowhere?" Paper presented at the 86th Annual Meeting of the Transportation Research Board, 2006.

Focus

The paper examines the Metro Green Line in Los Angeles, which has been criticized for being a "Line to Nowhere." The authors address criticisms that the Green Line does not connect major activity centers and was not likely to generate sufficient ridership to justify the investment by noting that, in fact, it serves major employment and carries more riders than the critics would expect. One important reason is the line's important role as a connector to both the Blue Line and bus lines in its service area.

Methodology

The authors use internal agency ridership numbers to track the growth of ridership on the Green Line versus the other rail lines operated by the Los Angeles County Metropolitan Transportation Authority (MTA). Ridership on the Green Line increased from 13,650 average weekday boardings in 1996 to 37,487 a decade later, an average annual growth rate of 12 percent. The authors also collect line-by-line bus route ridership and station boardings-and-alightings to illustrate the important role that bus-to-rail and rail-to-bus transfers are playing in increasing Green Line ridership.

Findings

The authors find that the many Green Line riders use the line as a feeder to the Blue Line, which provides service between downtown Los Angeles and Long Beach, or as a trunk line fed by the strong arterial bus routes that cross the Green Line. The authors conclude that the Green Line is succeeding by serving non-traditional transit markets.

Mierzejewski, Edward and William Ball. 1990. "New Findings on Factors Related to Transit Use." *ITE Journal* (February 1990): 34–39.

Focus

The authors identify the choice factors that affect individuals' decisions to use transit.

Methodology

The authors conducted a telephone survey of 4,000 persons in 17 selected MSAs who had public transportation available within one-half mile of their homes.

Findings

The authors found that the attractiveness of the automobile was the primary deterrent to transit use, although 22 percent of respondents reported that their place of employment was not served by transit. The survey results also confirm the traditional view that CBD-bound commuters are an important transit market. Of the choice riders, 82 percent worked in the central city and the majority of them listed parking availability as the main reason for using transit.

Miller, Mark, Larry Englisher, Rick Halvorsen, and Bruce Kaplan. *Transit Service Integration Practices: An Assessment of U.S. Experiences.* California Partners for Advanced Transit and Highways Research Report 2005-7, 2005.

Focus

The authors present the results of their assessment of transit service integration practices. These practices may include infrastructure, fare payment, and/or special events/emergency service integration.

Methodology

The authors conducted an extensive literature review to identify service integration policies and to determine how these practices might be integrated within an agency's overall service strategy. They then undertook a two-stage survey of agencies that had implemented specific practices. The first stage survey included 100 agencies; the second-stage survey targeted specific examples of each service integration policy and sought more detailed information about the objectives, effectiveness, and lessons of the experience.

Findings

The authors note that although there has been little evaluation of the policies, there is a widespread belief among agencies that integration both serves the goals of the transit agency and benefits the customer.

Moore, James E. "Ridership and Cost on the Long Beach-Los Angeles Blue Line Train." *Transportation Research Part A* 27, no. 2 (1993): 139–152.

Synopsis

The first component of the Los Angeles rail transit system, the Long Beach-Los Angeles Blue Line light rail, has been in operation since July 15, 1990. The total cost per Blue Line boarding is substantially higher than the average for light and heavy rail systems recently examined by the U.S. Department of Transportation Urban Mass Transit Administration. The author argues that it is unlikely that Blue Line ridership will increase, because the most reliable predictors of rail transit ridership are not under policy control. If bus boardings are accounted for, the author states that the net result of the Los Angeles rail initiative has been a reduction in transit ridership.

Multisystems, Inc., J.W. Leas and Associates, and Oram Associates. *Fare Policies, Structures, and Technologies*. Transit Cooperative Research Program Report 94. Washington DC: Transportation Research Board, National Research Council, 1996.

Focus

The authors provide guidance to transit agencies in making decisions about fare policies, structures, and technologies so that agencies can successfully implement appropriate strategies and enjoy the service efficiency and/or ridership benefits that might result from such changes.

Methodology

The authors consulted literature to identify different fare policies, structures, and technologies, consulted the National Transit Database to conduct preliminary agency interviews, and then undertook 12 detailed case studies for a mix of large, medium, and small ridership agencies.

Findings

The authors identify a set of fare policy goals, chronicle fare payment and collection technology issues, and discuss attempts to identify the ridership and revenue impacts of fare changes versus other factors. On this last point, the authors repeatedly emphasize the challenges of controlling for other external factors (employment levels, fuel prices, suburbanization, and transit service level, for example) and the problems of missing or inconsistent data that often frustrate the use of time-series regression techniques, which are seen as the best statistical methodology to use to isolate the effects of various factors. The authors do note that fare changes appear to have had effects on ridership, which is not surprising given the extensive literature on fare elasticity.

Multisystems, Inc., Mundle & Associates, Inc., and Simon & Simon Research and Associates, Inc. *Fare Policies, Structures, and Technologies: Update*. Transit Cooperative Research Program Report 94. Washington DC: Transportation Research Board, National Research Council, 2003.

Focus

This report updates TCRP Report 10 (published in 1996) in order to examine new types of pricing strategies and technologies.

Methodology

The authors reviewed literature on fare structures, policies, and technologies, and conducted detailed case studies of the use of these new structures and technologies by 13 transit agencies.

Findings

The authors document the increasing use of electronic fare media, efforts to integrate fare media regionally, and the use of innovative fare policies (like employer-based and university-based pass programs) to increase ridership among targeted groups. The authors conclude by noting that the shift to electronic fare media will aid agencies to better serve their existing markers while also attracting new riders.

O'Toole, Randal. *Rail Disasters 2005: The Impact of Rail Transit on Transit Ridership: An Update to Great Rail Disasters*. Reason Foundation Policy Study 336, 2005.

Focus

This report is an update to the author's earlier work. The author attempts to show that rail transit investments have not led to ridership increases in the cities that have constructed these systems.

Methodology

The author collected transit ridership and performance data from the Federal Transit Administration and the American Public Transportation Association databases, plus motor vehicle travel statistics from the Federal Highway Administration for the period 1982 to 2003 for the 23 metropolitan areas that have rail transit systems. He then examines trends in each of these metropolitan areas. He uses both passenger miles and unlinked trips as his ridership measures.

Findings

The author makes note of five key findings regarding transit ridership: (1) it is falling in 13 of the 23 metropolitan areas, (2) it is increasing slower after rail construction than before it in four metropolitan areas, (3) it is increasing but slower than the growth in vehicle travel in three metropolitan areas, (4) it is growing just as fast as auto use in one metropolitan area, and (5) it is growing faster than auto use in two metropolitan areas (Boston and San Diego). The author then examines four metropolitan areas that have bus-only transit where transit ridership is growing faster than auto use (Austin, Charlotte, Las Vegas, Louisville, and Raleigh-Durham).

The author's central argument is that metropolitan areas that have invested in rail transit have wasted their citizens' money. He contends that the investment has often resulted in less transit ridership because agencies have frequently responded to rail cost overruns by raising fares and/or cutting bus service, and he uses the experience of Los Angeles to illustrate this point. He closes by calling for changes in national transportation policy to reform grants programs that provide incentives for metropolitan areas to choose expensive rail transit projects in order to get their fair share of federal aid dollars.

Parker, Terry, Mike McKeever, G.B. Arrington, and Janet Smith-Heimer. Statewide *Transit-Oriented Development Study: Factors for Success in California*. Sacramento, CA: California Department of Transportation, 2002.

Focus

The purpose of the study was to define the concept of transit-oriented development, identify its potential benefits, identify barriers to its widespread implementation, document what appears to be working well, and develop strategies to promote more widespread use of the concept.

Methodology

The underpinning of the review is a set of 12 detailed case studies of transit-oriented developments in the state. For each development, the authors obtained land use, socioeconomic, and travel data as well as information about TOD-supportive public policies and records of development activity.

Findings

The report encompasses descriptions of each TOD site (which were used to build a web-based database) and recommendations about policy that should promote more use of TOD. The authors rely on descriptive statistics to make their case that TOD sites have higher transit ridership, but there is no attempt made to control for other potential influences. The authors distinguish between the types of transit available at each site, but they do not discuss larger service structure issues.

Parsons Brinckerhoff Quade & Douglas, Inc. *Transit and Urban Form.* Transit Cooperative Research Program Report 10, Chapters 1 and 2. Washington DC: Transportation Research Board, National Research Council, 1996.

Focus

This report examines the relationship between urban form (which consists of urban structure, density, land use mix, and land use design) and transit ridership.

Methodology

The report is essentially a literature review compilation of an extensive set of prior empirical work on the topic.

Findings

The authors note a number of key findings from their own and other research:

From their own study of 17 cities with light rail and/or commuter rail, the authors report that residential densities have a strong influence on rail transit boardings and that CBD size and density is also a strong influence on rail ridership.

From their own study of Chicago and San Francisco, the authors note that residents of higher density residential areas are more likely to walk to access transit.

From their own study of Chicago and San Francisco, the authors note that residents of more traditional (pre-1950s) neighborhoods are more likely to use non-automobile modes than residents of suburban (post-1950s) neighborhoods.

The authors also report extensively from other literature on the link between the CBD and transit ridership, the roles of employment clusters (other than the CBD) as ridership attractors, the importance of higher residential and employment density in correlating with higher transit ridership and/or mode shares, and the roles of land use mix and design in enabling transit to be a more viable mode for trips that might otherwise be undertaken

by automobile. However, the authors note that density is often correlated with land use mix and design, and that separating the effects of these factors from the effects of density is often quite difficult.

Pickrell, Don. "A Desire Named Streetcar: Fantasy and Fact in Rail Transit Planning." *Journal of the American Planning Association* 58, no. 2: 158–176, 1992.

Focus

The author compares the forecast and actual ridership, and the forecast and actual capital costs of eight rail transit projects in the United States in an attempt to verify the accuracy of the forecasts and, when forecasts are inaccurate, to identify the reasons for the inaccuracies.

Methodology

The author collects data on forecast ridership and cost for eight rail transit projects (four light rail and four heavy rail) in eight cities (Atlanta, Baltimore, Buffalo, Miami, Portland, Sacramento, Washington) and compares these figures to actual ridership and cost data. His primary sources are databases and reports compiled by the Urban Mass Transit Administration (forerunner of the FTA).

Findings

The author finds that planners consistently overestimated ridership and underestimated costs for these rail projects. He then investigates potential explanations for the discrepancies. He finds that the errors are not associated with flawed assumptions about key variables like population and downtown employment (which turned out be fairly accurate) nor are they the result of changes in the design of the projects. He instead attributes these overoptimistic forecasts to the structure of the federal transit grant programs.

Pisarski, Alan. *Commuting in America II*. Washington DC: Eno Foundation, 1996.

Synopsis

The author provides a portrait of commute travel in the United States using data obtained from the 1990 Census. The author points to the decentralization of population and employment in U.S. metropolitan areas as a primary cause of the decline in transit mode share. The report implies that transit is tied to a traditional, mono-centric urban form, and that, as this urban form disappears, transit will decline. But there are exceptions, as the author notes in the cases of Orlando, Tampa, Phoenix, San Diego, Houston, and Los Angeles.

Polzin, Steve and Oliver Page. *Ridership Trends of New Start Rail Projects.* Report 350-11. National Center for Transit Ridership, 2003.

Focus

The authors report ridership trends of new start light rail transit projects constructed between 1980 and 2001.

Methodology

The authors obtained system descriptive data and system service and ridership data from the American Public Transportation Association and the National Transit Database. They examined a total of 24 light rail transit (LRT) systems. The analysis involved very basic trend examination. They employed unlinked passenger trips as their basic measure of ridership. Thus, the figures may be inflated by more reliance on transfers after introduction of the LRT service.

Findings

The authors found that ridership trends for the rail projects, in the authors' words, "matured quickly." Ridership increases tended to be substantial in the immediate aftermath of system opening and then became relatively stable. They attribute subsequent growth in ridership to changes in system extent and service frequently. Despite the positive effects of the LRT lines on overall transit ridership, the authors note that transit continues to play a modest role in overall metropolitan travel. Nevertheless, the authors believe the LRT investments may be important in stimulating community attention and further investment in transit in the metropolitan area.

Pratt, Richard and John Evans. *Bus Routing and Coverage*. Transit Cooperative Research Program Report 95, Chapter 10. Washington DC: Transportation Research Board, National Research Council, 2004.

Focus

This chapter is part of a larger study of traveler responses to transportation system changes. This chapter examines rider responses to changes in bus transit routing. These changes include: new bus systems and system closures, bus system expansion and contraction, changes in geographic coverage, and routing and coverage changes that might be made in tandem with fare changes.

Methodology

The authors provide an overview of literature on the topic from the 1970s to the end of the 1990s, and report elasticities of ridership with respect to each of the routing and coverage changes. The authors also provide more detailed case studies for several cities.

Findings

The authors found elasticities in the range of 0.6 to 1.0. The authors noted that the largest ridership increases occurred when the system emphasized "high service level core routes, consistency in scheduling, enhancement of direct travel and ease of transferring" (5). The authors claim that new and expanded systems of the hub-and-spoke variety produced slightly higher ridership than grid systems, although there were no controls for other possible variables.

Project for Public Spaces, Inc. and Multisystems, Inc. *The Role of Transit Amenities and Vehicle Characteristics in Building Transit Ridership*. Transit Cooperative Research Program Report 46. Washington DC: Transportation Research Board, National Research Council, 1999.

Focus

The report explores the importance of waiting-area, vehicle, and service-related amenities in increasing transit ridership.

Methodology

The report includes case studies of the successful use of low-floor buses in Ann Arbor, commuter buses in Aspen, transit shelters in Portland, transit shelters in Rochester, and historic streetcars in San Francisco. The report includes some data on cost and ridership for each of the case studies. There is no discussion of other factors that might explain the ridership increases documented for the case studies nor is data collected that would enable a reader to do so.

The report also contains a transit design game and an accompanying workbook that agencies can employ to survey their patrons about the relative importance of various amenities in determining their use of transit.

Findings

The report is largely informational as opposed to evaluative.

Pucher, John. "Renaissance for Public Transport in the United States?" *Transportation Quarterly* 56, no. 1 (2002): 33–49.

Focus

During the mid and late 1990s, a series of articles appeared documenting a large decline in transit ridership during the early part of the decade. This study examines ridership over the entirety of the decade to identify trends and possible causes for those trends.

Methodology

The author collects data from the American Public Transportation Association and the National Transit Database, including unlinked passenger trips, vehicle miles of service, fares, and subsidies, and data from the Census Bureau and Bureau of Labor Statistics, including population and employment statistics. The author uses these data to prevent a descriptive account of transit ridership trends.

Findings

The author emphasizes the crucial role played by transit ridership in the New York metropolitan area in driving national transit statistics. He identifies the economic recession of the early 1990s, and particularly its effect on employment in New York, as

the driving force behind the ridership decline of the early 1990s. He cites the economic recovery of the 1990s, rising gasoline prices, stable fares, improved service quality, and the expansion of rail transit services as among the key contributing factors for the ridership rebound of the latter part of the decade. The limitation of this article is that it is purely descriptive; it makes no effort to examine the ridership trend and its potential causes using more sophisticated multivariate techniques.

Pucher, John and John Renne. "Socioeconomics of Urban Travel: Evidence from the 2001 NHTS." *Transportation Quarterly* 57, no. 3 (2003): 49–78.

Focus

The authors analyze the results of the 2001 National Household Travel Survey to document urban travel trends and differences in travel behavior among different socio-economic groups.

Methodology

The authors extract descriptive tables from the 2001 NHTS to identify differences in travel behavior based on geography, income level, auto ownership, race, and ethnicity of individual travelers.

Findings

The authors document a continued decline in transit use and corresponding growth in vehicle travel. The authors find that the poor, blacks, Hispanics, and those with low levels of vehicle ownership are more likely to use transit than are other groups.

Pushkarev, B. and J. Zupan. *Public Transportation and Land Use Policy.* Bloomington, IN: Indiana University Press, 1977.

Synopsis

This book examines the relationship between transit service supply, transit demand, and urban density. It is based on an earlier study prepared for the Regional Plan Association. The key insights, from the perspective of transit ridership and system performance, are that transit use is higher at higher urban densities. The authors also point out that auto ownership is lower (even when controlling for income) at higher densities.

Richmond, Jonathan. *Transport of Delight: The Mythical Conception of Rail Transit in Los Angeles.* Akron, Ohio: The University of Akron Press, 2005.

Synopsis

Richmond characterizes his book as " study about the failure of thought and its causes. It starts with a bizarre decision: to construct a comprehensive rail passenger system in an environment where it appears incapable of providing real benefits" (1). The development of Los Angeles's rail transit system is the focus, although most insights are undoubtedly applicable to other settings. In 1980, Los Angeles County politicians proposed increasing

local sales taxes to fund transit improvements. The centerpiece of their proposal was development of an ambitious regional rail transit system to serve both downtown Los Angeles and major suburban communities. This plan was universally criticized by transportation academics who argued that fixed rail transit, a 19th century technology, poorly served the travel needs of a dispersed, late 20th century metropolis. Yet their criticisms were ignored, and both policymakers and the public embarked on the quest to build what Richmond characterizes as a "transport of delight." So, why did Los Angeles decide to embark on a multi-billion dollar rail development program?

Richmond uses the history of the first segment, the $1 billion Blue Line that connects downtown Los Angeles to Long Beach, to answer this question. He argues that the policy decision was based on a constellation of metaphors that combined to form a powerful myth about rail transit's ability to solve the region's traffic congestion problems. This myth led policymakers to embrace rail and to discount the use of buses, which he says are actually the better-suited transit mode for dispersed metropolitan areas.

For proponents, rail transit appeared to provide a simple answer to the unbearable traffic problems of Los Angeles. They perceived rail as being faster, more comfortable, more secure, more efficient, and more attractive to middle-class riders than buses. They perceived rail, which operated on its own tracks outside traffic, as a solution to the congestion problem, while they saw buses, which operated in the midst of the traffic, as contributors to the problem. Lessons drawn from personal experience added further supportive evidence. Policy makers traveled to other cities and experienced what they perceived to be successful rail transit systems. Surely, they stated, Los Angeles could develop its own successful system. Thus, a myth based on a combination of common sense and personal experience developed to lead policy makers, and eventually a majority of the electorate, to embrace rail transit even though the empirical evidence in support of this decision was limited at best-and the results have been less than the proponents imagined.

Richmond provides comparative cost and performance data on rail transit and bus transit systems in Los Angeles and elsewhere to support his arguments.

Rosenbloom, Sandra and Gordon J. Fielding. *Transit Markets of the Future: The Challenge of Change*. Transit Cooperative Research Program Report 28. Washington DC: Transportation Research Board, National Research Council, 1998.

Focus

The authors examine an array of anticipated demographic, geographic, technological, and economic changes and analyze how these changes will affect transit. They then identify potential future transit markets and the services that might be used to serve them.

Methodology

The authors use a combination of quantitative analysis of larger trends, literature review on trends and transit service, and case studies of individual transit operators.

Findings

The authors identified 13 service concepts that appeared to be effective in increasing transit ridership and 10 niche markets in which they were successful in doing so. They use these insights to identify the most efficient and equitable service concepts: reverse commute services, services to large employers (including universities), vanpool incentives, route restructuring, and feeder services. The authors advise that "carefully targeting services to user needs and preferences" is critical to maintaining or increasing ridership (4).

Schumann, John. "Progress and Survival: Assessing Transit Changes in Two State Capitals: Columbus and Sacramento, 1985–2002." Paper presented at the 2005 Annual Meeting of the Transportation Research Board, 2005.

Focus

The author examines transit ridership and system performance in Columbus and Sacramento in 1985 and 2002. The two state capitals pursued different transit paths during this period; Columbus remained an all-bus system, while Sacramento opened a light rail transit system.

Methodology

The author uses a combination of quantitative data from the US Census Bureau and the American Public Transportation Association combined with qualitative insights derived from his prior professional experience to present the two descriptive studies.

Findings

In 1985, the transit system in Columbus (COTA) outperformed the system in Sacramento (SRTD). By 2002, the roles had reversed. In the intervening period, Sacramento had successfully opened a light rail transit system and then restructured its bus system to provide riders with the ability to reach a wider array of destinations. Columbus failed to build light rail and instead retained an all-bus system. The author notes that different levels of local financial support explain both Sacramento's ability to develop light rail and Columbus's failure to do so.

The author states:

> [I]n Sacramento, willing political leadership took advantage of a one-time opportunity for federal funding to build a light rail transit (LRT) starter line, that adding LRT made transit more visible and effective, encouraging voter approval of additional local operating and capital funding, and that all of this resulted in a synergy that attracted more riders to the total LRT and bus system, and led to extension of the rail system to a third corridor in 2003. Although planning for light rail transit was begun in Columbus during these same years, a serious interruption in the flow of local funds hampered transit development,

requiring cuts in bus service and preventing development of that region's LRT line which, had it been built, could have enhanced transit's attractiveness (2).

Siregar, Falatehan. *Characteristics of Cities with Rapid Transit*. University Microfilms International, 1991.

Focus

The objective of this study is to identify the characteristics of cities and urban areas which are associated with rapid transit systems as part of the urban multimodal transportation system.

Methodology

This dissertation studies the characteristics of global cities which have utilized rapid transit (100 cities in 1986) and a global sample of cities which do not have rapid transit (100 cities). Data are collected on eighteen variables which include population size, growth rate, and density of the central city and metropolitan area, automobile registrations per 1000 population, city bus ridership, the existence of a tramway system in the city, the number of large banks located in the city, the country's economy, and whether it is a capital city. These variables are used to test the hypotheses and to analyze the most important factors which are associated with the occurrence of rapid transit systems in cities. Two by two cross tabulations, a linear probability model, and a quadratic logistics discrimination analysis are used in this study.

Findings

The research found that two of the most important city characteristics associated with rapid transit utilization are city population size and level of automobile ownership. The larger the population size and the higher the number of automobiles per 1000 population, the greater the occurrence of rapid transit systems. This study also found that rapid transit systems world-wide are growing in number, and that the largest growth of rapid transit ridership is being generated by rapid transit systems in developing countries.

Skinner, Jon. *Elderly and Youth Bus Ridership: A Comparison of Routes in Miami-Dade County.* Master's degree paper, Department of Urban and Regional Planning, Florida State University, 2007.

Synopsis

The author examines the performance of routes classified on the basis of the percentage of elderly or youth riders in order to distinguish routes with disproportionate numbers of these riders from other routes. He then examines these routes in terms of ridership, productivity, and the extent to which the route meanders. He finds that routes with high percentage of elderly riders have lower ridership and poorer performance than other routes and also tend to characterized by significant route meandering that is indicative of service that diverts from arterials to serve neighborhoods and provide more "front door" type service. These routes tend to repel both elderly and non-elderly patrons. The author notes that larger numbers of elderly patrons actually use the traditional routes that provide more direct service along arterials. The preferences of elderly patrons tend to be a lot like other transit users -they, too, value more direct and higher speed service.

Spillar, Robert and G. Scott Rutherford. "The Effects of Population Density and Income on Per Capita Transit Ridership in Western American Cities." Paper presented at the 60th Annual Meeting of the Institute of Transportation Engineers, 1998.

Focus

The authors examine the relationships between both residential densities and income on transit ridership in Denver, Portland, Salt Lake City, San Diego, and Seattle.

Methodology

The authors obtain data on per capita transit use, total population, annual income, and geographic acreage from the 1980 U.S. census and local data sources. They then estimate multivariate models that predict transit ridership at the neighborhood level.

Findings

The authors find a strong density effect, however the effect varies depending on the income of the neighborhood. Density appears to have a stronger effect in lower income neighborhoods.

Taylor, Brian, Peter Haas, Brent Boyd, Daniel Hess, Hiroyuki Iseki, and Alison Yoh. *Increasing Transit Ridership: Lessons from the Most Successful Transit Systems in the 1990s.* San Jose, CA: Mineta Transportation Institute, 2002.

Focus

The authors identify and analyze strategies used by transit agencies that enjoyed ridership increases between 1995 and 1999.

Methodology

The authors conducted a survey of 103 agencies and learned that a majority had expanded services, restructured routes, and developed new marketing strategies, including promotion of partnerships with universities, large employers, and other major activity centers. Surveyed agencies also cited the importance of population growth and economic conditions as factors that strongly influenced transit ridership. The authors followed the initial survey with more detailed case studies of 12 systems. These case studies revealed that among the most important internal policy initiatives undertaken were: fare restructuring, coordination with employers, and route restructuring. Route restructuring included elimination of low-productivity routes, suburb-to-suburb commuter services, and the introduction of specialized services (welfare-to-work transportation, medical transportation).

Findings

The authors conclude that while many factors that affect transit ridership are beyond the control of agencies, creative managers can still employ a combination of strategies and enjoy positive results.

Taylor, Brian D. "Unjust Equity: An Examination of California's Transportation Development Act." *Transportation Research Record* 1297 (1991): 85–92.

Focus

This paper examines the consequences of California's Transportation Development Act, which provided dedicated transit funding for all counties, on subsidy and performance of urban versus suburban operators.

Methodology

The author compares suburban and center-city operators on a number of performance dimensions.

Findings

The author argues that the allocation formulas of the Act have strongly favored lightly-patronized suburban service over more heavily-patronized urban services. The result has been a proliferation of new, well-funded, and expanding suburban operators that attract few riders while older, more heavily-patronized central city operators are forced to cut service because of funding shortfalls. The author calls for a redirection of subsidy to central city operators. This recommendation is in line with the traditional view that transit should focus on serving a CBD and central city market.

Taylor, Brian D., Douglas Miller, Hiroyuki Iseki, and Camille Fink. "Analyzing the Determinants of Transit Ridership Using a Two-Stage Least Squares Regression in a National Sample of Urbanized Areas." Presented at the 2004 Annual Meeting of the Transportation Research Board, 2003.

Focus

The authors investigate the factors that explain transit ridership in 265 urbanized areas in the year 2000.

Methodology

The authors estimate a two-stage, least squares regression model that predicts transit ridership as a function of regional geographic characteristics (population, population density), metropolitan economic characteristics (household income, housing prices), population characteristics (race, age, percent below poverty), auto and highway characteristics (fuel prices, percent carless households), and transit system characteristics (fares, coverage, frequency).

Findings

The authors find that the most important determinants of transit ridership variability among the urbanized areas are: metropolitan area size, median housing costs, and percent of households that do not own an automobile. They also find that transit service levels and fares are also associated with ridership, with elasticities generally within ranges cited in the literature.

Tennyson, Edson L. “Analysis of Saint Louis Metro-Link Performance.” Paper presented at the 2005 Annual Meeting of the Transportation Research Board, 2005.

Focus

The author provides an overview of transit agency performance in Saint Louis between 1946 and 2002 using a wealth of historic quantitative data on transit patronage, service, cost, and fare revenue. The author provides more detailed discussion of the 1991 to 2002 period, which brackets introduction of light rail transit service.

Methodology

The author gathers a wealth of statistical information from the National Transit Database, U.S. Census Bureau, agency databases and publications, and industry databases and publications. The author compiles this information to present a statistical portrait of the transit system in the post-war period.

Findings

The author notes that light rail service began as part of an effort to restore the viability of transit service in the metropolitan area. He points out that the results were “immediate and positive” (2). Transit ridership increased 40 percent, and the cost of providing service stabilized after a period of continued increases.

Thompson, Gregory and Jeffrey Brown. “Explaining Variation in Transit Ridership in U.S. Metropolitan Areas Between 1990 and 2000: A Multivariate Analysis.” *Transportation Research Record* 1986 (2006): 172–181.

Focus

The authors identify and examine the key determinants of transit ridership change between 1990 and 2000 in U.S. metropolitan statistical areas (MSA) with more than 500,000 persons. Among the key variables they examine is a service orientation that distinguishes between multidestination and traditional service orientations.

Methodology

The authors obtained data from the US Census Bureau, US Bureau of Labor Statistics, and National Transit Database. They estimated multivariate models for the percent change in ridership (passenger miles per capita) between 1990 and 2000 for three different MSA groups: all MSAs, medium MSAs (1 million to 5 million persons), and small MSAs

(500,000 to 1 million persons). The explanatory variables included: 1) 1990 passenger miles per capita; 2) percent change in urbanized area density; 3) West region (dummy variable); 4) change in ratio of rail service to total service; 5) percent change in service frequency; 6) percent change in service coverage; 7) percent change in MSA population; 8) percent change in unemployment rate; 9) percent change in black population share; 10) percent change in Hispanic population share; and 11) multidestination service orientation (dummy variable).

Findings

The authors found that transit is growing most rapidly in the non-traditional markets of the West but that much of the regional variation is a function of the particular service coverage, frequency, and orientation decisions made by transit agencies in this region. Service coverage and frequency are the most powerful explanatory variables for variation in ridership change among MSAs with 1 million to 5 million people, while a multidestination service orientation is the most important explanation for variation in ridership change among MSAs with 500,000 to 1 million people. A weakness of the analysis is the definition of the multidestination variable as a binary variable, as opposed to a continuous one.

Thompson, Gregory, Jeffrey Brown, Rupa Sharma, and Samuel Scheib. "Where Transit Use is Growing: Surprising Results." *Journal of Public Transportation* 9, no. 2 (2006): 25–43.

Focus

Using data obtained from the National Transit Database, the authors identify the kinds of metropolitan areas where transit ridership increased from 1990 to 2000.

Methodology

The authors report descriptive statistics for ridership, service, and service productivity by Census region and MSA population size class to identify places where transit use is growing.

Findings

This paper essentially investigates whether transit's fate is tied to the last vestiges of old urban forms or whether transit is finding niches in the new, largely suburban urban forms that increasingly have manifested themselves since the 1920s. The hypothesis is that most growth is in census regions with the strongest vestiges of older urban forms centered on CBDs. The method to test the hypothesis is to document how transit performance changed between 1990 and 2000 in U.S. metropolitan areas with more than 500,000 people in the year 2000. The results show that for MSAs with fewer than 5 million people, transit use has been growing faster than very rapid population growth in the West region, but not elsewhere in the country. The conclusion is that transit growth is not tied to old urban forms.

Thompson, Gregory L. and T. G. Matoff. "Keeping Up with the Joneses: Planning for Transit in Decentralizing Regions." *Journal of the American Planning Association* 69, no. 3 (2003): 296–312.

Focus

The authors investigate the relationship between service orientation and transit system performance using comparative case studies of transit systems in decentralized metropolitan areas that have pursued multidestination versus radial service approaches.

Methodology

The authors obtained data on transit system profiles and transit performance from 1983 to 1998 for transit systems in Cleveland, Columbus, Houston, Minneapolis, Pittsburgh, Portland, Sacramento, San Diego, and Seattle. The performance measures include cost per passenger mile, peak-to-base ratio, passenger miles per capita, and vehicle miles per capita. The authors then compared systems that met their definitions of multidestination versus radial service orientations on each of these measures.

Findings

The authors found that multidestination systems were more effective (higher ridership), nearly as efficient (about the same cost), and more equitable (lower peak-to-base ratio) than radial systems.

TranSystems, Inc., Planners Collaborative, and Tom Crikelair Associates. *Elements Needed to Create High Ridership Transit Systems.* Transit Cooperative Research Program Report 111. Washington DC: Transportation Research Board, National Research Council, 2007.

Synopses

The report includes case studies that focus on the internal and external elements that contributed to successful ridership increases and examines how the transit agencies influenced or overcame internal and external challenges to increase ridership. The report is simply a list of the different strategies employed with no evaluation of performance of the strategy. Most strategies relate to fare policy or the development of services targeted at specific customer subgroups through marketing.

TRL Limited. *The Demand for Public Transport: A Practical Guide*. TRL Report TRL 593, 2004.

Focus

This study is an update of the 1980 report The Demand for Public Transport. The report presents the results of numerous studies on the factors influencing the demand for public transportation.

Methodology

The report is a compilation of numerous other studies.

Findings

The report presents the study results as elasticities of ridership with respect to the specific set of factors that are discussed. The report includes chapters on fares, time (travel, access, and wait), other aspects of service quality, income, car ownership, and land use. Among the key findings are the following:

Fare elasticities vary depending on both mode and time-frame. Bus fare elasticities average around -0.4 in the short run, -0.56 in the medium run, and -1.0 in the long run. Rail transit elasticities tend to be higher than those for bus for suburban rail services and smaller than those for bus for heavy rail. Off-peak ridership tends to be twice as responsive to fare changes as peak period ridership. Elasticities also tend to vary with metro area size and trip length.

Elasticities with respect to time dimensions of service quality tend to be larger than those for fare. People are especially sensitive to changes in wait and access time and less sensitive to changes in in-vehicle travel time. Elasticities with respect to other dimensions of service quality are very modest.

Income tends to suppress bus ridership and car ownership (especially for the first car) tends to suppress bus ridership as well.

Land use effects on transit ridership tend to be very small but measurable.

Turnbull, Katherine and Richard Pratt. *Transit Information and Promotion*. Transit Cooperative Research Program Report 95, Chapter 11. Washington DC: Transportation Research Board, National Research Council, 2003.

Focus

This chapter is part of a larger study of traveler responses to transportation system changes. This chapter examines ridership responses to marketing and customer information services.

Methodology

The authors use a combination of literature review and case studies to develop estimates of the effects of different marketing and customer information strategies.

Findings

The authors found significant variation in the effectiveness of the different strategies. By and large, strategies targeted at specific populations (identified through market research) and/or specific traveler needs were more effective than mass-targeted strategies.

Urbitran Associates, Inc., Multisystems, Inc., SG Associates, Inc., and Robert Cervero. *Guidelines for Enhancing Suburban Mobility Using Public Transportation*. Transit Cooperative Research Program Report 55. Washington DC: Transportation Research Board, National Research Council, 1999.

Focus

The authors seek to provide guidance to transit operators and local policymakers to enhance suburban mobility through traditional and non-traditional transit services.

Methodology

The authors use an extensive literature review to develop categories of suburban land-use environments and a typology of service strategies. They then conducted detailed case studies of 11 US and Canadian transit operators to determine the kinds of strategies that appear to be most effective in suburban environments.

Findings

The authors used their analyses to develop 12 key findings about transit in suburban environments that can serve as guidance to operators and local policymakers. Their recommendations include: 1) develop service around focal points; 2) operate along moderately dense suburban corridors; 3) continue to serve transit's traditional demographics; 4) link suburban services to the regional line-haul network; 5) target markets appropriately; 6) economize on expense; 7) adapt vehicle fleets to customer demand; 8) creatively adapt transit service practices to the landscape; 9) obtain private sector support; 10) plan with the community; 11) establish realistic goals; and 12) develop supportive policies, plans, and regulations, especially as pertains to land use and development policies.

Urbitran Associates, Inc., Cambridge Systematics, Inc., Kittelson and Associates, Inc., Pittman and Associates, Inc. and Center for Urban Transportation Research. *Guidebook for Evaluating, Selecting, and Implementing Suburban Transit Services*. Transit Cooperative Research Program Report 116. Washington DC: Transportation Research Board, National Research Council, 2006.

Focus

This report is an update of TCRP Report 55 and is paired with a web-only document that details the eight case studies that are briefly presented in the guidebook. The purpose of the study is to examine the current status of suburban transit, from both operations and land-use perspectives, and to develop guidelines for evaluating, selecting, and implementing these services (1).

Methodology

The authors consulted literature as preparation for conducting 28 preliminary case studies scattered throughout the United States. The authors interviewed key informants at each of the systems, and collected information about the types of services offered, subsidy policies, the land use patterns of the area in which the agency operated, and information about the policy objectives underlying the specific types of services that are offered.

The authors used insights gained from these preliminary case studies to develop a procedure for gaining more detailed information about eight systems that offer a range of suburban services and are located throughout the United States.

Findings

The authors used the information obtained from both the preliminary and detailed case studies to develop a set of lessons about suburban transit services. They found: 1) the best performing services (measured in passengers per hour) are among the least flexible; 2) the best performing routes are among those serving the most balanced mix of land uses; and 3) services that target specific groups (such as seniors or students) seem to be among the most productive. The authors call for additional research on suburban alternatives to traditional fixed-route transit service.

Vuchic, Vukan. *Urban Transit: Operations, Planning, and Economics*. Hoboken, NJ: John Wiley and Sons, 2005.

Synopsis

This is a textbook on public transportation. It includes discussions of transit system operations and networks, transit agency economics and organization, and transit systems planning and mode selection. The book's discussions of transit users and transit network structures are most relevant to our examination. It offers discussions of factors that influence transit travel (especially level of auto ownership), and it differentiates between route structures and service philosophies. The remainder of the book is more useful to practicing transit planners than to researchers.

Whately, Lynne Marie, Bradley E. Friel, and Gregory L. Thompson. "Analysis of Suburb-to-Suburb Commuter Rail Potential: Metrolink in Southern California." Proceedings of the Seventh National Conference on Light Rail Transit 2 (1997): 175–183

Focus

The authors determine whether passenger demand for suburban-oriented commuter rail service exists in the Los Angeles area. The authors estimate Metrolink patronage potential and market penetration of suburb-to-suburb commute markets and compare them to the equivalent measures for the suburb-to-downtown Los Angeles commute market.

Methodology

The authors classified station-to-station pairings as serving either suburb-to-suburb trips or suburb-to-CBD trips. They stratified trips by distance: less than 11 miles, 11 to 20 miles, 21 to 30 miles, and greater than 30 miles. They formulated two hypotheses. First, they hypothesized that no significant difference existed in size or penetration of the two types of markets for a given distance category. Second, they hypothesized that as distance increased, market size decreased but market penetration increased for each type of pair.

The authors obtained data on all firms with more than 50 employees and the number of employees in each zip code from the Southern California Air Quality Management District. They defined market size using two-mile buffers drawn around each station. Zip codes were then placed inside buffers as appropriate. Workers who both lived and worked in the zip codes inside the buffers were considered potential rail passengers. They then obtained actual ridership data from an onboard passenger survey conducted by Metrolink, the commuter rail operator. They used these data to calculate an achieved potential ratio (APR), the ratio of actual riders to potential riders, for each station-to-station pair.

Findings

The authors classify the pairings and APRs by station pair category and distance category. They find that the ridership potential for the average suburb-to-suburb station pair is three times greater than for suburb-to-CBD. They observe that most of the suburb-to-suburb potential is found in the shorter distance categories (under 20 miles), that the market potentials are about even for trips between 21 and 30 miles, and that the market potential for suburb-to-CBD is greater in the 31-plus mile trip distance category. They also find that market penetration is negligible for suburb-to-suburb trips in the shorter distance categories but larger in the longer distance categories. In general, as distance increases, so does market penetration.

The authors conclude by emphasizing the significant market potential for suburb-to-suburb trips. They suggest that more frequent service and fare structures oriented to short distance riders might be strategies to tap these markets. They also note that rail lines should continue to serve traditional CBDs and attempt to serve nearby suburban employment clusters as well.

ABOUT THE AUTHORS

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Jeffrey R. Brown is Assistant Professor and Master's Program Director in the Department of Urban and Regional Planning at Florida State University. He holds a PhD in Urban Planning from the University of California at Los Angeles. Dr. Brown's research explores the role of public transit in decentralized environments, the influence of finance and professionalization on the evolution of transportation planning and development of the American freeway, and topics in transportation finance and state and national transportation policy. He has published articles on these topics in *Urban Studies*, *Transportation*, *Transportation Research Record*, *Journal of Planning Education and Research*, *Journal of Planning History*, and *Journal of Public Transportation*.

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PEER REVIEW

San José State University, of the California State University system, and the MTI Board of Trustees have agreed upon a peer view process to ensure that the results presented are based upon a professionally acceptable research protocol.

Research projects begin with the approval of a scope of work by the sponsoring entities, with in-process reviews by the MTI research director and the project sponsor. Periodic progress reports are provided to the MTI research director and the Research Associates Policy Oversight Committee (RAPOC). Review of the draft research product is conducted by the Research Committee of the board of trustees and may include invited critiques from other professionals in the subject field. The review is based on the professional propriety of the research methodology.

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