Review of Recent American Light Rail Experiences

Robert T. Dunphy, Urban Land Institute

A review of new light rail systems opened in the United States since 1980 is presented using generally available transit system characteristics, U.S. Census data, and selected additional information. An update of experiences with the three cities studied in the last major federal assessment is contrasted with an overview of San Diego, which was not included, and five new light rail systems. Recent market trends for individual regions are presented, as are current local development policies.

The typical measure of success in a new light rail system is ridership. Because this number is the most understandable to the public—and therefore to the media—it is often the single metric used to determine whether a new system is a winner or a loser. To develop a more complete understanding of ridership success, however, it is important to evaluate not only the goals of the project, but also the broader travel trends in the target market.

RIDERSHIP: MARKET SUCCESS OR BEAN COUNTING?

Most major transit investments (all of those with federal funding) have a number of stated ridership goals that can be used to rate the results. The least reliable, but most carefully scrutinized, are the estimates of ridership on the initial operating segment. As the clock ticks down to opening day, the pressure is on the transit agency to predict the number of riders. As factors that affect the ridership—the strength of the economy, fares, changes in bus service, and so on—become more clear, it is possible to "refine" the estimate of initial ridership, usually with technical procedures different from those used for the longer-range forecasts. Often the transit agency estimate is revised downward, so that initial ridership exceeds the forecasts and the system is proclaimed a success. The cynics have seized on these revisions, however, to charge that the numbers have been manipulated to make the transit agency look good.

Serving the Market

A major trend faced by most transit systems is that they are losing market share, primarily because of major changes in the commuting market. Figure 1 shows the trend for the prime commuting market: workers who live and work in the central county. Both Denver and St. Louis showed an actual decline in such workers between 1980 and 1990, and Buffalo and Portland grew only slightly. The major growth counties were in San Diego, Sacramento, and Los Angeles, although it is likely that in Sacramento and Los Angeles, especially, much of this growth consists of people living in the suburbs and working at suburban job locations not well served by the new rail lines. Policies to encourage de-
Development in the city of San Diego have probably kept the new workers closer in, thereby supporting transit. The trends suggest that most new light rail cities are fighting a suburbanizing labor market, both new workers living outside and out commuters from the city, both of which are less likely to use transit than workers who actually live in the city.

Recent trends in the number of commuters using transit for their usual commute mode (a decennial census definition) are compared for the new light rail cities and other selected urban areas (Figure 2). Two of the 1980s’ light rail cities showed significant loses in total transit commuting: Buffalo (—25 percent) and Portland (—20 percent). One the plus side, San Diego racked up the largest relative increase in transit commuting of any large urban area: 43 percent. Sacramento was slightly in the black at a modest growth of 2 percent. Among other light rail systems that have opened since 1987, all were in cities with a net loss in transit commuting during the 1980s: San Jose, Denver, Baltimore, and St.
Louis. The worst of these was St. Louis, where commuting by transit plummeted by 42 percent.

Trends in the transit market share for commuting shown in Figure 3 indicate that only San Diego increased the regional percentage of workers using transit to work. This finding simply confirms the powerful locational trends indicated earlier, in which much of the growth in the commuting market consists of workers who live and work in the suburbs and commute by automobile.

Meeting Expectations

Another way to judge the ridership figures is to compare them with what was expected. As indicated, this comparison is complicated by the diversity of assumptions on transit operations, regional growth, and other transportation policies. One attempt at such comparisons was made by the Volpe Transportation Systems Center in what will be referred to here as the TSC study (1). It analyzed four heavy rail systems, four light rail systems, and two people-movers. The study, described in a Seattle Times article as "widely criticized, but never discredited," hit some sensitive nerves. Of the four light rail systems it covered, the three new ones were in Buffalo, Portland, and Sacramento. The TSC study estimated that the Portland rail line carried about half of the projected ridership, whereas Buffalo and Sacramento ridership was only about a third of that projected. The TSC study did not include projects that did not receive local funding, the most prominent of which was the San Diego Trolley, where the initial line was constructed with only local and state funds. San Diego estimated a ridership of 50,000 during the 1990s, a target that was reached early, before the deteriorating economy took its toll on ridership.

One criticism of the TSC study was that it was undertaken too early, before the systems had a chance to mature. There is now about a decade of experience in Portland and Buffalo, and there has not been dramatic ridership growth to change the early assessment. The Sacramento system will be 7 years old this year and shows no significant upward move in ridership, in part because of the California economy.

Among the newer systems, the next three to open—San Jose, Los Angeles (LA) Blue Line, and Baltimore—followed the pattern identified in the TSC report of overestimating ridership and underestimating costs. There was one upside surprise in St. Louis, where the initial ridership was substantially higher than anticipated and the construction was completed on time and within budget. The hope is that agencies and consultants are getting better at both cost estimating and projections. Indeed, the Santa Clara County Transportation District revised its travel forecasting models and ran a

![FIGURE 3 Commuting trends, automobile versus transit (7).]
current estimate that came close to today's ridership levels.

**Total Transit Trip Volume**

The final perspective on ridership is simply the volume of rail trips. The best of the new light rail systems is that in Calgary, which carries 110,000 daily trips. The only two other systems that carry at least 40,000 riders daily are San Diego and St. Louis. Estimated 1995 ridership in San Jose and Baltimore is only about 20,000 daily, whereas the new 5-mi line opened in Denver in 1994 carries about 14,000 riders. Most of these numbers are expected to be much higher, in some cases because of system expansion. Lower ridership numbers can be justified if the costs are scaled down properly, but their regional impact will be substantially lower. Figure 3 shows the dramatic growth in commuting trips made as automobile drivers and passengers between 1980 and 1990. Clearly, for transit to make a difference in regional mobility, substantially higher levels must be attained.

**Affordability For the 1990s**

The second most closely watched numbers on new rail systems are the cost indicators. One of light rail's attractions to smaller cities that cannot justify heavy rail is its affordability (2). In fact, the title of one TRB Light Rail Conference was “Successful Systems at Affordable Prices” (3). However, if judging ridership is complicated, it is child's play compared with judging cost. Three perspectives at affordability are taken here: the investment cost per trip, current operating costs, and “sticker price” from the perspective of the local buyer, transit agency, and participating governments.

**Capital Investments**

The most difficult concept for many in the transit community is the Federal Transit Administration (FTA) cost-effectiveness measure of cost per incremental rider, which has both technical and philosophical problems. One of the gripes of many transit advocates is that federal criteria would always lead to the least-cost investment, and that this ignores the fact that different transit investments (notably bus and rail) have different status. In the context of consumer decisions, for example, one might choose to buy a flashy car when one could have gotten by with a $6,000 used car. If this same approach is taken to recent light rail investment, it is possible at this stage to see what people eventually bought, without making value judgments for now whether it was worth it. Using the data from Table 1, it is possible to calculate an investment cost per daily rider that might compare, for example, with an individual's investment in a car. This assumes that each rider makes two round trips daily. The results show that, using 1995 numbers,

San Jose, LA Blue Line, Buffalo, and Baltimore were the luxury models of the new light rail systems. Picking typ-

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<tr>
<th>LRT Line</th>
<th>1995 Weekday Riders</th>
<th>Aver. Rider per Mile-Weekday</th>
<th>Capital Cost 1994</th>
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<th>Capital Cost per Round Trip</th>
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<td>18.2 6,044</td>
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<td>$388</td>
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Source: Unpublished data from BRW Inc.

Assumes Average Rider makes two trips per week day.
ical vehicles, for example, the San Jose system, with an investment of $64,000 per daily rider, is in the top-of-the-line BMW category, which is probably fitting for Silicon Valley. The LA Blue Line and Buffalo's expensive underground construction put them in the Lexus LS400 category, while Baltimore's light rail prices out at about a Cadillac Seville.

Portland, San Diego, and Sacramento fall in the middle range with investments of about $18,000 to $23,000 per daily rider, respectively—about the level of a Ford Taurus. St. Louis' new line also falls in the same cost range.

The economy models are the new Denver line—which is roughly equivalent to a Honda Civic—Calgary, and Edmonton, which were even more affordable than the U.S. systems. Their construction costs were higher, but the ridership is substantially more so.

These, of course, are not directly comparable investments, because cars probably have a useful life of about 10 years whereas the light rail system has an economic life of two or three times that. It does, however, add a different perspective on investment costs. Assuming that about half of the rail riders are "new" to transit, loading the investment costs only on them, the way FTA criteria suggest, would double the investment levels. These costs could come down as ridership grows on the existing lines. In most cases, however, the case for growth in ridership is based on new extensions, so that only if the incremental costs of new riders are lower than today's averages will the overall per-capita investments come down.

Operating Costs

Capital costs may be of greater concern to federal officials, but the major cost burden of new rail systems to local agencies is the operating costs. Part of the rationale for major transit projects is that a capital investment will offer more economical operating costs. The costs of transit trips on different systems are presented in Table 2. Comparing them with driving costs requires that the fixed cost and the operating cost be separated. One of the criticisms of automobiles is that they are expensive to operate if all costs are taken into consideration but that drivers often ignore the ownership costs of depreciation, insurance, and such as a fixed cost that they will have unless they sell the car—an unlikely prospect.

Ideally, a light rail system has two advantages over buses: it is cheaper to run because one operator serves a whole train, and fares can be higher than buses because it is considered premium service. This appears to be true in San Diego, Portland, and Buffalo. However,

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<th>TABLE 2 New Light Rail Systems, Current Daily Costs ($)</th>
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*Fare and Subsidies were projected by assuming the % of operating funds from fares were the same for all modes.
†Annual cost calculated using OMB recommended discount rates at 4.8% for a 20 year period (factor= 0.0792).
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Data not available for Canadian and recently completed light rail systems.
the operating costs of new lines in Los Angeles ($3.70) and Baltimore are more than double the costs of the average bus trip. In Baltimore, light rail operating costs are even more expensive than Baltimore's subway costs (that is a whole different story). The fact that both are in a startup mode certainly contributes to this, as do the currently low ridership levels. In San Jose and Sacramento, the current costs of rail and bus are about equal.

**Affordability**

The critical factor of the affordability of a new transit system appears to be similar to that of a family buying a new car; it is not whether it can be justified, but whether it can be paid for. This is no problem for systems paid for with federal or state money. In St. Louis, for example, the local match for the initial federal grant was $109 million in asset values of donated rights of way. In Baltimore, the state of Maryland picked up the full local match for the heavy rail system. The initial 22.5 mi of the light rail system were financed without federal funds, and the three counties put up $45 million, 13 percent of the costs. In San Jose, where bus and rail operating costs are significantly higher than in Sacramento and San Diego, and where 85 percent of the cost is subsidized, there appears to be no concern on the part of the public to pay the cost. In fact, citizens voted an increase in the sales tax in 1992 (still pending a legal challenge) to support these services.

If voting with your pocketbook is a means of support, the clear winners are in Portland, where area voters approved in November 1994 a $475 million bond issue to finance the local share of a $2.85 billion north-south light rail line. In nearby Seattle this spring, however, voters turned down the $3 billion needed to match a $6.7 billion regional system. Sticker shock may be responsible for drastic cutbacks in the light rail system in Los Angeles from 296 to 95 mi.

**Relieving Congestion**

One of the best selling points for new light rail systems is that they can help relieve congestion by attracting drivers off the road. The FTA cost-effectiveness criterion is directly relevant, counting only new-to-transit trips, generally automobile travelers who would not have used the next best transit alternative. The congestion argument is complex, in part because transit works best when the road system is congested so it can provide a better option. Most of the analyses show that congestion will be reduced compared with the alternative future scenario. Those who inhabit the real world will never see the more congested alternative to know how much better things are—they will only observe that congestion is getting worse even with transit. Even if analysts describe properly the congestion relief aspects of new transit proposals, it is easy for plan proponents and the media to pitch this more sexy goal. As shown in Figure 4, congestion at the regional level has continued to worsen for all of the new light rail cities. Of course, most of the systems are too new to make a difference. In San Diego, for which there are 10 years of congestion data after the initial opening, congestion has grown the fastest—mainly because of the explosive growth of the 1980s. Beginning in 1989, congestion growth slowed in a number of current and future rail cities, probably because of the economic recession.

Another angle on the reduction of congestion is that significant transit investments will allow people to drive less. As shown in Figure 5, however, there is significant variation in comparative levels of driving and transit among different regions. Among the nine new rail cities studied, the one with the most driving is St. Louis, which also had the second lowest per-capita transit use in 1990. Baltimore's transit riding was twice that of Buffalo, but people in Baltimore also drove more. A review of these comparisons, as well as the full range for all cities (e.g., Atlanta residents used transit at a level of 50 percent higher than those of Portland and drove twice as much) suggests that there is a much more complex interaction between driving and transit, with influences due to demographics and geography as well as the transportation systems.

**Making Land Use Connection**

Getting serious about transit involves making a deliberate connection between transit investment and land use decisions. It is not enough to follow the "field of dreams" model—build it and they will come. As demonstrated, there are strong market pressures for decentralization, which can undermine even the best planned rail lines. In many cities it is relatively easy to build popular support for light rail. It is much more difficult to achieve consensus on building the communities needed to make them work.  

**Development Trends and Prospects for New Light Rail Cities**

A brief rundown of regional development trends in the new light rail cities, beginning with the oldest systems, finds the following (4):
San Diego

San Diego's initial success was despite, rather than because of, regional development policies. It has only been since the 1990s that the city and the transit agency have embraced transit-oriented design guidelines. The initial light rail line took advantage of an opportunity—the flooding of a railroad line that presented the opportunity to acquire the right of way. After strong growth in the 1980s, San Diego is mired in the recession that continues in California. The good news is that the Urban Land Institute's (ULI's) recent survey suggests that San Diego is one of six markets to experience significant positive shifts in momentum (four of the other five are also in California). Moreover, the most important new transit-oriented design project is now under construction.

Buffalo

Buffalo is among the least bullish markets in the ULI survey. Light rail in Buffalo has not sparked the economic resurgence that backers had hoped to see. Clearly, more is needed to turn around Buffalo's moribund economy.

Sacramento

Sacramento is also on Ken Rosen's top 10 list among low-cost inland markets. Sacramento was one of the first cities to adopt transit-oriented design guidelines and has one of the first projects, Laguna West. But there are vast areas of the surrounding county without development restrictions, and no reasons that developers should stop at the city line.

Santa Clara County

Santa Clara County is one of the leaders for positive momentum shifts. There have been attempts to achieve agreement on development among participating jurisdictions, but there are still problems in reaching regional consensus on growth. There have been some recent initiatives for joint development and transit-oriented development, in some cases through the reuse of parking lots.
FIGURE 5 Transit trips versus vehicle miles traveled, 1990.
Los Angeles

The Los Angeles story is much bigger than light rail. The region has opted for transit improvements in a big way, with aggressive light, heavy, and commuter rail. There are some major planning policies and a few deals to cluster development near some of the future rail terminals.

Baltimore

The Baltimore economy showed negative momentum on rentals and sales. Despite extensive state transit funding, Maryland's mass transit administration has no formal mechanism for involving local governments in transit-friendly land use discussions. According to a spokesman, Todd Spangler, "We're very hands off about that. We don't get involved unless we're asked to, and we've never been asked that I know of" (5).

St. Louis

The ULI survey showed the momentum in St. Louis is negative. There is much enthusiasm over the new rail line, and the transit agency has commissioned studies on how best to capture the value for development purposes.

Denver

The Denver economy appears hot these days. It is on the favored growth list of both Ken Rosen and Bill Wheaton, of the Massachusetts Institute of Technology. One concern for transit will be in growing the prime transit market, central city workers, which declined slightly in the 1980s.

Transit-Oriented Design in San Diego

The first transit-oriented development (TOD) in San Diego is Rio Vista West, a 90-acre mixed-use development adjacent to the future Mission Valley East Trolley line. It was approved by the city council in December 1993, and construction began in 1994. The plan called for more than 1,000 units of moderate-density housing, 165,000 ft² of office space, and 325,000 ft² of highway-oriented retail. The developer, Don Cerone, vice president of CalMat Properties and a participant in the development of the city's TOD guidelines, supported the general concept of developing in a transit-friendly way. Nonetheless, some points of contention arose between developer and city objectives for Rio Vista West (as well as between the objectives of different city agencies):

- The developer found himself in the middle of a battle between the planners, who wanted narrow, walkable streets, and the public works staff, who were concerned about substandard streets and potential liability problems.
- Citing the importance of clustering people around transit, the city and the Metropolitan Transit Development Board (MTDB) argued for a higher residential density than the developer proposed. The developer successfully argued that 30 units per acre was the highest that was economically feasible.
- Although a highway-oriented shopping center with a 120,000-ft² discount superstore, supermarket, and drugstore appeared inconsistent with the philosophy of transit orientation, this component was critical to the project's economic feasibility. In the interest of getting a TOD under way, the city went along, a decision that was made easier by the developer's incorporation of several design strategies to weave the shopping center into the fabric of the community.
- MTDB has encouraged the city to require property owners along the Mission Valley line to dedicate right of way and pay some construction costs for the rail line as a condition of zoning approval. In this case, the developer argued successfully that he should not have to subsidize rail construction costs. After all, he was providing land to MTDB and, as a TOD, a much more extensive street grid than a suburban-style development. The streets are estimated to cost $2.5 million, which is more than the value of the land contributed for the trolley line (6).

This project demonstrates both the vision and the flexibility needed to take a concept and implement it in ways that satisfy current codes, transit goals, and market needs.

Light Rail in 1995: Lessons Learned

A recent article by Ken Orski pointed out light rail is now in the mature phase, characterized by "mature design, high level of engineering knowhow and confident estimates of construction and operating costs, which began with the St. Louis and Denver systems" and will continue with the opening of lines in new cities and extensions to current lines (2). It is hoped that past problems with overly optimistic projections of ridership and costs will be replaced with more realistic assessments. A badly needed resource is a thorough, objective evaluation of what has been learned among the nine new light rail cities, similar to the research that FTA has already begun on the new heavy rail systems in San Francisco and Atlanta. To be most useful, this study should include candid assessments by transit principals.
about what went right, what went wrong, and what will be recommended next time. It is especially important to suggest improvements to the technical procedures needed to produce credible forecasts. Many new cities are waiting in the wings; they are not well served by unduly positive reviews. Lacking such a thorough assessment, anyone can offer opinions, such as those of the author:

- **Light rail is expensive.** All of the recent data show that light rail represents a major expenditure of local and, especially, federal and state funds for the levels of ridership. The two obvious way to change the results are to reduce costs or increase ridership. It is hard to do much on the cost side. In fact, there are pressures to enhance mitigation and improve the quality of design that are likely to increase, not reduce, costs. The emphasis must be on increasing riders.

- **Light rail will not reduce traffic congestion,** at least on the scale in which it is practiced in the United States. G.B. Arrington, of Portland’s Tri-Met, points out that “the choice is between futures where congestion will be higher than today, even for the best transit option.” Congestion relief should be one of the best sales tools, though, since few residents will use transit but all would gain benefits from less congestion.

- **Light rail must be an effort in community building.** As indicated, the way to make rail systems more cost-effective is to increase ridership, which requires supporting the investment with consistent community development decisions. That means a decision on where the community wishes to grow, with appropriate policies to encourage growth in those places. It also means effective policies to preclude development in areas where land is less expensive and development costs may be cheaper. It could even go so far as parking policies that price parking to cover all costs and toll charges that vary between peak and off peak. Since pricing is so controversial, perhaps starting with the easy part—consistent development policies—is best.

**REFERENCES**