PART 4

CASE STUDIES

Five case studies are presented in this section. The case studies represent different geographic areas, city size, types of transit amenity projects, and budget scopes. Together, they show the impact of transit amenities on riders in specific communities, as well as how different transit agencies went about implementing the projects.

4.1 Site Selection Criteria

The following are among the criteria that were considered in selecting sites for the case studies:

- Projects illustrate "best practices" in that amenities and vehicle characteristics are generally considered to be positive by users and cost-effective by the transit agency.

- Projects allow for an internal comparison within a community (e.g., two different types of vehicles, an improved bus stop and one that is not).

- To make best use of research resources, amenities and vehicle characteristics considered had the following characteristics:

  – They are commonly considered by transit managers;
  – Their value is open to debate;
  – The cost of some features is not trivial;
  – They can be represented clearly and evaluated meaningfully on the type of survey instrument used.

- There is considerable transferability to other places in the U.S.

- Practitioners will find useful information and insights.

- Amenities and vehicle characteristics have had an impact on passenger experience.

- Obstacles have been overcome that are faced by other communities wishing to implement similar types of improvements.

- Projects were established or implemented long enough to be evaluated.

4.2 Methodology

For each detailed case study, a series of systematic data collection methods were undertaken to assess actual use and perception of specific projects. (The exact methodology used in each case study was tailored to the particular project, although methods for all case studies remained consistent in order to allow for cross comparison.)

Methods included both qualitative and quantitative assessments of on-board vehicles and waiting environments:

- Focus Groups. Focus groups were conducted with one group of transit managers, city officials and community representatives involved with the project and at least one group of transit users. Transit managers also were asked for their opinions about the kinds of information that would be most useful to them as a final product of this study. Additional community partners who were involved with the project (such as downtown associations or neighborhood groups) were invited to these focus groups as well.

- On-site surveys of users of the facility and vehicles were conducted in order to elicit general perceptions about the features, frequency of use, general demographic information, and suggestions for improvement. The Transit Design Game also was conducted with passengers on board transit vehicles. Surveys were pre-tested prior to finalizing the questions. (Detailed survey results are presented in Appendix B.)

  Surveys were distributed at selected transit stops (for measuring rider attitudes toward waiting environments) and on board vehicles (for measuring rider attitudes toward vehicle amenities.) Different transit stops were selected to represent comparative waiting environments (such as an "improved" transit stop and an "unimproved" transit stop) at different locations within the city. Heavily used transit stops were chosen in order to aid us in increasing the number of returned surveys. Surveys were distributed to all waiting passengers who appeared to be above the age of 16.

  On board vehicles, surveys were distributed to all riding passengers along selected routes. As with the transit stop surveys, we distributed surveys in comparative vehicles, such as on routes with low floor buses and on buses with a high floor design. We selected a representative sample of routes to capture different respondent demographics or transit usage.

- Additional interviews with transit operating staff (drivers, maintenance workers, etc.), local officials, representatives of downtown or neighborhood associations and other key individuals also were conducted.

- Behavioral observations and time-lapse filming of activities within and around the waiting environments were made when appropriate. These observations and studies of activity patterns were then evaluated to determine general types of uses and users, as well as problems users are experiencing. Time-lapse filming also was used as part of these behavioral observations.

4.3 Case Study 1 -- Low Floor Buses, Ann Arbor, Michigan

In 1993, the Ann Arbor Transit Authority (AATA) bought some of the first full-size low floor buses built in North America, making it the first transit agency in the United States to introduce these buses into widespread use. It had been using low floor paratransit vans to serve those of its passengers with disabilities since 1984. Today, more than half of the Ann Arbor transit fleet are low floor buses, and its conventional buses are being phased out altogether.

Low floor buses, which have wider aisles and no steps at either entrance, have proved to be a popular amenity with AATA passengers (see Figures 3 and 4). Moreover, the investment has been cost-effective: by eliminating the need for wheelchair lifts, the costs incurred for lift repair and maintenance have also been eliminated.

Project Goals

The primary intent in choosing low floor buses was to better address the needs of passengers with disabilities. For several years, the AATA had been trying to move people with disabilities from costlier door-to-door cab and van services to fixed route bus service. Initially, the agency was unsuccessful, because passengers with disabilities resisted riding buses with fallible wheelchair lifts. The low floor buses solved this problem and provided a way for the AATA to improve access and service efficiency for all customers in the process.

Design Process

In 1991, the executive director of the AATA, after having ridden low floor buses during a trip to Europe, began the risky process of introducing this new technology to Ann Arbor. At the time, other than low floor shuttles at New York's Kennedy Airport, no U.S. transit agency had even placed an order for low floor buses.

It was difficult for the AATA to find a manufacturer of low floor buses, and the company that eventually produced the buses was not even in production at the time. However, AATA was able to work closely with the manufacturer to develop specific design specifications to meet agency needs. After the second delivery of low floor buses, the AATA held focus groups with passengers to get their feedback and suggestions for further refinements.

Features

AATA has both 35- and 40-foot low floor buses: the 35-foot bus has 28 seats, while the 40-foot bus seats 36. (Conventional buses seat 44-46 people.) While the buses have fewer seats, they have more room per standee and wider aisles and can hold 90-100 seated passengers and standees (though more than 80 may cause discomfort). The agency also has 21-foot and 25-foot low floor buses used for paratransit service.

While there are no steps into the bus, Ann Arbor's low floor bus has two steps up to an elevated area in the back of the bus. The upper deck has seats facing each other, while the lower level seats face front. To accommodate passengers with disabilities, buses "kneel" to the curb and have ramps that flip out to rest on the sidewalk, although many users with disabilities find that they can enter even without the ramp. Complementing the low floor design are other features including a window in the back of the bus; operable windows; and a 9-foot-high ceiling. These features give the bus an open, airy feeling.

Impacts

Ridership Impacts

AATA ridership on its fixed route service has risen steadily since 1987, peaking in 1991 at about 3.9 million annually and remaining fairly steady through 1996. While the AATA does not claim that low floor buses have increased ridership overall, more of the system's passengers with disabilities are switching from more costly door-to-door paratransit services to fixed route bus service. The greater reliability of low floor buses has attracted wheelchair riders, and many elderly and people with disabilities have moved to Ann Arbor specifically because of the low floor buses and free transit service which make it possible for them to get around without a car.

Passenger Perceptions

As part of this study, approximately 150 transit passengers were surveyed about their impressions of the low floor buses versus the conventional buses. Passengers rated the low floor buses higher in terms of ease in getting on and off the vehicle (a significant 83%, compared to 58% aboard the conventional bus). Some passengers felt that low floor buses were slightly easier to walk through (66%) compared to a regular bus (54%).

Low floor buses were also rated much higher in terms of availability of schedule and route information (75%) than were the conventional buses (40%). This is an interesting finding because, according to the AATA, buses are re-stocked with this information nightly in the same place (behind the driver) on every bus. "The new low floor buses seem airier and roomier, so that everything seems to be more visible and more open," explains a service manager for the AATA, "and other people I asked had the same reaction." This allows passengers to identify stops and routes more easily.

Passengers rated the comfort and lighting aboard both buses equally, but rated the conventional bus higher for amount of seating (64% to 57%) and comfort of seating (55% to 42%). The conventional buses have about 10 more seats per bus, but the low floor buses accommodate more standees and provide them with wider aisles in which to stand.

Nearly all of the survey and focus group comments about low floor buses were favorable. Passengers believed that the low floor buses make it "easier for a person in a wheelchair to get in and out"; they are "better than going up and down steps where you can trip";

Figures 3 and 4. Low floor buses (with ramp deployed) Ann, Arbor, MI

"are more accessible when... seniors get on [with] these shopping carts"; and "it's really difficult for older riders and disabled riders to board the regular system." Other comments focused on their contribution to universal accessibility: "There's no doubt about it, everybody has to be able to ride the bus" and they help riders "feel good getting on [the bus] and feel good getting off of it." Some focus group participants complained about the two steps in the rear of the bus. However, drivers have commented that passengers sitting in these elevated seats are more visible, which the drivers find helpful.

Passenger Boarding

According to a study prepared for the AATA entitled, "Dwell Time Effects of the Low Floor Bus Design," dwell time benefits from the low floor design include "faster boarding by wheelchair patrons due to avoidance of lift operation and faster boarding and alighting by patrons using other mobility aids, those slowed by carrying parcels or children and potentially the non-disabled population due to the avoidance of interior steps."[34]

Not only is boarding more efficient, but with non-cash payment methods (tokens, monthly pass or discounted pass), dwell times are reduced even more, although not by a statistically significant amount. However, even "small dwell time savings may be magnified through avoidance of red lights" and "time savings may be greater in systems with larger numbers of slower moving and mobility aid-using passengers, with a per passenger time savings of between one and six seconds for these groups."[35] Furthermore, the wider aisles facilitate passenger circulation on board and are helpful for people with bundles, strollers, and packages.

Maintenance Impacts

While there were initial problems because these low floor buses were among the first produced, in general the cost per mile for maintaining the low floor and conventional buses has been equivalent. On conventional buses, the wheelchair lifts were constantly breaking down, particularly with the Michigan winters and salt on the roads. Conversely, the ramp system is simpler, experiences fewer problems, and is less costly to maintain.

Costs

The low floor buses were purchased using federal and state money. Standard and low floor buses cost about the same, in part because the low floor buses do not have an expensive ($20,000 to $30,000) wheelchair lift.

People with disabilities ride the bus for free, in an effort to lure them away from the more expensive paratransit service. Providing these riders with free bus service aboard low floor buses has proven to be less costly than subsidizing door-to-door cab service.

Conclusions

The investment in low floor buses in Ann Arbor, while initially risky, has set the example for other agencies across the U.S. Today, the agency is definitely sold on the advantages of low floor buses, and Ann Arbor plans to have the first all low floor bus fleet in the country.

4.4 Case Study 2 -- Commuter Buses, Aspen, Colorado

The Roaring Fork Transit Agency (RFTA), which serves all of Pitkin County, including Aspen, Colorado, has been steadily increasing ridership for the past eight years--with services that include free shuttle buses for skiers and shoppers within Aspen and a park-and-ride facility at the local airport. Realizing that many riders could be lured from their cars to commuter buses, RFTA set out to compete with the automobile for passengers specifically by making the commuter buses more comfortable. With limited resources, RFTA made minor design modifications to its standard buses, such as improved climate control, padded seating, reading lights, and a quieter ride. Changes like these have attracted discretionary riders to transit and have begun to impact travel choices of down-valley commuters and, ultimately, reduce congestion and improve air quality for the valley as a whole.

Project Goals

Aspen's increase in commuter traffic is directly related to its cost of housing. As Aspen has become less and less affordable, people who work there are commuting from further and further away, spending an average of two or more hours per day on a single, often congested two-lane road which connects Aspen to "down valley" communities.

The impetus for RFTA's amenity initiatives and its decision to double transit service and expand its service area was the impact that increased automobile traffic was having on the City of Aspen in particular and its air quality in general. By expanding and upgrading transit service (without drastically increasing fares), Aspen has been able to prevent the widening of the two-lane scenic highway which connects it to the rest of the valley. (At the same time, Aspen has instituted a strict paid parking program, which further encourages transit use.) "Even without the air quality impetus, we're dominated by automobiles in the valley," explains Kenny Osier, an RFTA manager. "We needed to reduce that dominance. People see that RFTA plays a vital role in achieving this goal."

Realizing that its main competitor is the automobile, RFTA did not simply try to increase reliability and frequency of service. Rather, it recognized that the bus needed to be more pleasant and user-friendly to serve existing riders and attract new commuters.

Design Process

RFTA has a strong customer orientation: the agency surveys passengers frequently to gather information about bus design and service issues and relies on them for feedback. In addition, the agency uses phone calls and comment cards. Passenger input gathered by annual surveys helped identify and prioritize desired amenities before the buses were ordered.

RFTA worked directly with the bus manufacturer to improve the design of the buses and was open to manufacturers' suggestions about how to best achieve the goals. When RFTA was ready to order more buses in 1994, the agency presented a request for

proposals to three different manufacturers. In the project specifications, RFTA indicated that the manufacturer should consider the private automobile to be its competition, not other bus manufacturers. Rather than providing rigid specifications, RFTA set basic parameters and let manufacturers suggest specific features to make the bus quieter and comfortable. "That ability to work with us made a big difference," said an RFTA manager. "The manufacturer was responsive to our concepts."

Other features such as bicycle and ski racks, which were a priority among passengers, were developed in a cost-sharing partnership. The racks were initially rejected by the manufacturer because of the projected research and development costs, but RFTA insisted that the racks be included in the bus design. A compromise was reached in which the agency did all the research and development and the manufacturer built and installed the racks.

Features

Before the new buses were purchased, RFTA commuters traveled on older conventional buses, often purchased secondhand from other agencies. The new design features and amenities added to the buses purchased in 1994 had, therefore, an even more dramatic impact:

- Carpeted sidewalls and ceilings. Upholstery is used to deaden wind noise and vehicle rattle.

- Reading lights. These lights allow passengers to sleep while others are reading, avoiding the need for unpleasant cabinwide fluorescent lights after dark or before dawn (see Figure 5).

- Comfortable padded seating. RFTA tried airline-style high-back reclining seats, but found that they were uncomfortable for taller passengers and that people didn't like that the seats in front of them reclined back into their place. Now the buses have mid-back seats, which still retain some sense of privacy but eliminate the other problems (see Figure 6).

- Bicycle/ski racks. Every bus has ski and snowboard racks attached to its exterior right-hand side which accommodate a variety of equipment. In the spring and summer, racks are added to the front hood of buses and provide space for four bikes. There is a $2 per bike fee for use of the bicycle racks.

- Extra layer of soundproof insulation. This also helps prevent heat loss during winter.

- Baseboard heating. This is quieter than the under-seat forced air heating that it replaced.

Impacts

Ridership Impacts

Ridership has been increasing 15% every year for the past 7 to 8 years, for an aggregate increase in growth of 72%, significantly outpacing population growth. (Regional population hovers around 55,000.) RFTA counted 3.7 million boardings in 1996. The increase in transit miles traveled has been significant as well. In 1991, RFTA buses traveled about 300,000 miles along Aspen city routes and 770,000 on down-valley routes. By 1996, city route mileage had nearly doubled to 500,000 and down-valley routes had almost tripled to 2.2 million. Basically, as more transit riders move further away from Aspen, buses have to travel further to reach them.

Passenger Perceptions

RFTA surveys its customers two to three times per year. According to a recent survey, both the frequency and reliability of bus service received high marks, with 89% of commuters strongly agreeing that bus service was reliable, and 62% that buses are frequent enough; about 58% of passengers questioned by RFTA said that the buses were comfortable and 66% agreed that the cost to ride the bus is reasonable. In addition, 44% of passengers rated RFTA's overall quality of service as excellent, and 47% stated that it was good.

According to the detailed passenger surveys conducted for this study, 78% of passengers rated the overall comfort of the new commuter buses as "good," compared to only 32% of passengers on the older buses. This discrepancy indicates that added amenities are perceived by passengers to make their ride more pleasant. Similarly, 74% of respondents rated seating comfort on the new bus as "good" while only 19% rated seating on the older buses as "good." Nearly three quarters (72%) of riders rated the amount of seating on the newer buses as good, compared with only half (52%) of riders on older buses. The reclining mid-back padded seats are widely preferred to the unpadded "plastic" seats on the older buses, particularly by those traveling longer distances. Also, passengers noticed improved lighting on the newer buses: 70% rated it as good, while only 42% of riders rated the standard lighting on older buses as "good." In fact, passengers like the reading lights so much that some older buses have been retrofitted to include them. Finally, 59% of commuters on newer buses (with the carpeted ceilings and sidewalls and additional insulation) considered the ride to be smoother and quieter, as compared to 30% of travelers on the older buses.

Overall, these improvements have an impact on passenger ridership: 52% of passengers on the newer buses said that their vehicle's features make them more likely to use transit and 54% claimed that the features make them more likely to recommend that a friend take transit. On the older buses, these likelihoods were reduced to 10% and 11% respectively.

Maintenance Impacts

By and large, the design changes RFTA made to its buses were cost-effective. Maintenance costs for the newer vehicles have not been significantly higher than for the older buses. Osier explains that "if you give people something nice and keep it nice, people also tend to keep it nice." RFTA also finds that maintaining the few amenities is insignificant compared to the cost of increasing service, which is another way to increase ridership.

Costs

One and one-half percent (1½%) of Pitkin County's total sales tax is dedicated to transportation improvement projects countywide: 70% of this funding goes to RFTA, accounting for 80% of the agency's budget. In addition, the revenues collected from parking in downtown Aspen are dedicated for use by RFTA. Funding for the new commuter buses came from a $3 million grant from the Federal Transit Administration.

Perhaps the most significant aspect of Aspen's vehicle improvements is that they added very little cost to the overall price of the buses. Without the extra features, the purchase price for each bus is about $250,000. The padded, upholstered seats cost an additional $5,000 per bus. The manufacturer included the carpeted interiors at no extra cost. Overall, the amenities described above -- the comfortable seats, bike racks, reading lights, sound insulation, carpeting, and heating -- added about $8,000 to the cost of each bus.

Conclusions

According to RFTA, the improvements they have made to Aspen's buses might seem minor, but they have contributed significantly to passenger experience. RFTA feels that because of concern on the part of some transit agencies that negotiating with vehicle manufacturers over amenities will take too long and cost too much, they end up not making changes to their vehicles. By using a cooperative approach with the manufacturer, however, RFTA was able to implement design improvements to its vehicles quickly and cost-effectively.

Figure 5. New Neoplan bus with passenger reading lights.

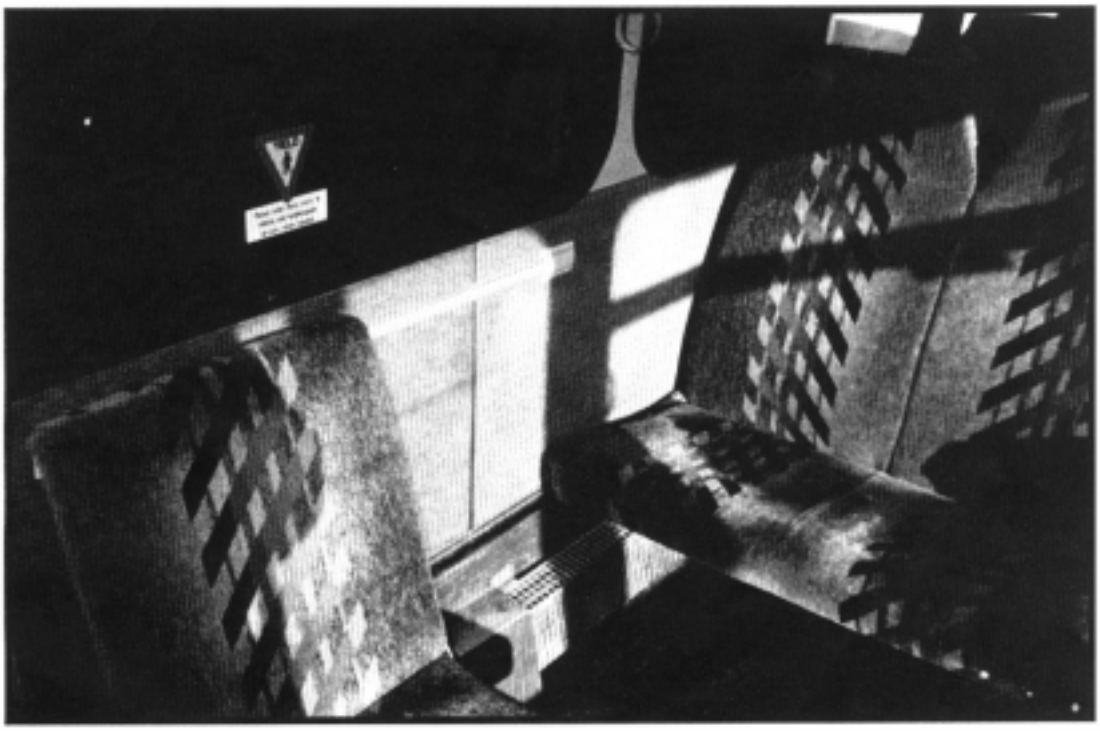

Figure 6. New Neoplan bus with padded, reclining seats.

4.5 Case Study 3 – NW 23rd Avenue & Transit Mall Shelters, Portland, Oregon

For the past 25 years, the City of Portland, Oregon, and the city's transit agency (Tri-Met) have worked together to provide transit amenities that contribute to the revitalization of both downtown and neighborhood commercial districts. The first step was the withdrawal of a proposal, early in the 1970s, to construct two major freeways and to invest the funds in expanded transit service instead.

From the outset, Portland's Transit Mall was conceived of as the City's center, with Pioneer Courthouse Square, a multi-modal transit center, located at the center of the transit mall. It was built in order to encourage transit use and to revitalize the downtown and has indeed been successful.

This project set the stage for other transit amenity projects in neighborhood commercial districts, as well. The City's decision to widen sidewalks and install shelters at bus stops along NW 23rd Avenue, for example, was made to alleviate pedestrian congestion and speed transit operations along this busy but narrow street. Ridership on the Avenue's #15 bus line continues to grow.

Project Goals

Both the transit mall and the NW 23rd Avenue curb extension project were made possible by the decision of Portland's leadership in the early 1970s to promote transit and discourage suburban sprawl and the automobile dependence that it spawns. The transit mall project was the linchpin of the 1972 Downtown Plan, the fundamental principles of which are still being implemented today. These include the promotion of transit, the development and maintenance of a high-density north/south transit spine, and the coordination of transit access with development.

The idea for the transit mall was initially proposed by the downtown business community and property owners in the early 1970s in order to

- Alleviate automobile traffic congestion and pollution in the downtown;
- Avoid the construction of costly and space-devouring parking;
- Control and focus growth in the city; and
- Make their businesses accessible and attractive to pedestrians in this booming metropolitan area.

While on a much smaller scale, the goals of the NW 23rd Avenue transit improvement project were similar:

- To make transit service more efficient by allowing buses to stop in the travel lane, reducing illegal parking at bus stops, and increasing parking on the street;
- To provide additional space and amenities for transit patrons and reduce pedestrian-transit rider conflicts on sidewalks; and

- To make street crossing distances safer and shorter -- increasing the ability of pedestrians to see and be seen by oncoming cars and buses.

Design Process

In January 1973, Tri-Met initiated an UMTA-funded (now the FTA) feasibility study for the Transit Mall. The study results were favorable and construction of the mall began two years later in 1975; it opened in 1978. Because the transit mall was planned as an urban design, transit and economic development project, all the designs and features were added at the same time, rather than incrementally (or after the fact), and the program issues (such as traffic lanes, artworks, and the location of information kiosks) were coordinated with design measures. The City hired the firm of Skidmore Owings and Merrill to design the transit shelters. The location of the shelters was decided on a building front-by-building front basis. The decision to keep one lane of vehicular access through portions of the mall came about as a compromise: the Federal government would not have given the city money to enhance a street for cars, yet the property owners were not going to support the complete removal of automobiles.

The NW 23rd Avenue Curb Extension project was conceived in 1978 as part of the district-wide Northwest Portland Transportation Study and finally won approval in 1989, partly because the idea was a new one and partly due to an extensive (and protracted) community involvement process, including an active, broad-based citizens advisory committee. As is typical in Portland, the advisory committee played an active role in planning the project to make sure that broader issues of congestion, parking, and the needs of businesses on the street were addressed. To identify optimal sites for curb extensions and placement of its new transit shelters on NW 23rd Avenue, Tri-Met conducted pedestrian counts and placed transit service at locations of highest potential use. Finally designed in 1990, the sidewalk extensions were completed in 1992.

Features

In addition to 31 passenger shelters serving seven service areas, Portland's Transit Mall's widened sidewalks feature trees, sculptures, fountains, planters, banners, street furniture, brick-paved sidewalks, and trip itinerary planning kiosks (see Figure 7). The mall, which has continuous bus lanes running for 11 blocks along two parallel streets, serves 200 buses per hour traveling in each direction, allows for one lane of automobile traffic and intersects with the MAX light rail line. The shelters themselves are designed to provide weather protection for up to 60 persons at a time. They are constructed from bronze with curved glass walls and polycarbonate roofs and feature benches, telephones, and televised bus schedule and route information. There are two shelters on each 200-foot-long block.

The NW 23rd Avenue project is comparatively modest. Sidewalks were extended at only three intersections on the street: Irving, Flanders, and Everett. Each extension is about 30-feet long (the distance between the front and back doors of a standard bus) and runs the width of a parking lane, adding about 8 to 10 feet to the sidewalk (see Figure 8).

Transit shelters with seating, phone booths, trash receptacles, and newsboxes were added to the bus stops at these intersections.

Impacts

Ridership Impacts

Ridership in Portland has been growing fairly steadily over the past two decades. Since 1971, annual originating rides (annual bus boardings excluding transfers) on Tri-Met have grown from 14.7 million in 1971 to 49.2 million as of 1996, growing an average of about 750,000 per year. Ridership data show a 19% increase in ridership specifically on the #15 line, which serves Northwest 23rd Avenue, between 1994 and 1995, which followed a dip of about the same percentage in 1991.

Passenger Perceptions

The smaller shelters located on the curb extensions on NW 23rd Avenue and the large shelters located along the transit mall received very similar ratings from the passengers surveyed at each. This demonstrates that, while these shelters are very different in size and level of amenity, both adequately serve the needs of populations that use them. In addition, a large percentage of passengers rated both the transit mall and NW 23rd as good for "ease in walking to the stop" and for "amount of space/width of sidewalks," which indicates that both curb extensions and pedestrian-oriented designs work well for transit users. However, there are some significant differences. Riders rated the availability of bus schedules and route information more highly on the transit mall (71% rated this as good) than on NW 23rd Avenue, where only 36% said this was good. The curb extensions at the three bus stops at Everett, Flanders, and Irving streets led 72% of passengers surveyed there to rate ease in boarding the bus as good, as compared to only 52% of passengers boarding the bus on the transit mall.

Passengers were surveyed along NW 23rd Avenue at bus stops located at Everett, Irving, and Flanders streets regarding their perceptions of the street and transit shelters to see whether the curb extensions along NW 23rd or the traffic-calming measures in the pedestrian-friendly transit mall affected perceptions of safety or comfort. Pedestrians agreed (by a smaller margin than transit passengers) that the bus stops would make them more likely to ride and recommend transit and that both NW 23rd and the transit mall were "pleasant places to walk."

Passengers waiting on NW 23rd Avenue expressed a desire for more seating, lighting, and waste receptacles as well as schedule and route information. Concerns of transit mall passengers included: reducing undesirable activities there (drug dealing, panhandling), providing restrooms, heated shelters, more seating, and better lighting; and improving cleanliness.

Maintenance Impacts

The Portland Transit Mall itself has one of the best mall maintenance programs in the country and it has served as a model for other cities. Mall attendants not only clean the sidewalks and remove garbage, but also act as "greeters" and provide maps and directions to visitors and transit passengers alike. Tri-Met maintains the shelters, the brickwork and other transit or shelter-related features and the City and property owners (through Alliance for Portland Progress) maintain everything else.

There are expenses related to the maintenance of the transit mall shelters. Their bronze skin has been deemed too soft for future application at heavily used transit locations. The bronze railings and other features located next to passengers are repainted every two years. The curved glass walls are expensive and it can take two people one day to do the necessary disassembling of the shelter in order to replace the glass. The U-shaped sides, openness to the street and ease of access for boarding, Tri-Met believes, are worth the maintenance costs incurred.

The shelters along NW 23rd Avenue are much smaller and easier to maintain, but Tri-Met is planning to replace 550 polycarbonate-walled, steel frame shelters system-wide with new shelters that have an aluminum frame, glass-paneled walls, and a translucent plastic roof. The agency opted for clear roofing in order to let in more sun and street light. At night, this feature improves passenger perceptions of safety. Lastly, one of the shelter's sidewalls is removable so it can be replaced with an advertising display panel. Once the last structure is in place, Tri-Met will begin to administer its own bus shelter ad program, with an estimated annual revenue of $1 million.

Costs

Because of the way in which the transit mall was built, and the holistic design process it underwent, the costs for the features were also lumped together. Be that as it may, when the transit mall shelters were built in the mid 1970s, they cost approximately $60,000 each, but their replacement cost today is closer to $200,000 a piece. Funding for the project was composed of federal transit money with matching funds from the City of Portland. Tri-Met is currently modifying its transit mall shelter design, reducing the size of the U-shaped curves and making them smaller to fit a 60-foot right-of-way for bus stops at Portland State University. These will cost $90,000 without either site preparation or installation.

The total cost for the twelve curb extensions included in the NW corridor project was $325,000. Some of the money came from interstate transit dollars diverted from highway projects to street enhancement efforts under the ISTEA legislation. The City funded its 15% share (ISTEA match) from gas taxes. To contain costs and minimize disruption to the street when the curb extensions were added, the contour of the existing sidewalk slope was simply extended into the street, so that the curb is actually minimized. The shelters located on NW 23rd Avenue cost $2,500 each installed; these constituted Tri-Met's contribution to the curb extension project.

Figure 7. Bus Shelter, Transit Mall, Portland, OR.

Figure 8. Bus shelter on a curb extension, NW 23rd Avenue, Portland, OR.

Conclusions

Both the transit mall project and the bus stop extensions on NW 23rd were conceived and implemented in a larger context for improving transportation options and the livability of the City of Portland. This overall vision, which is shared by the city and the transit agency alike, represents a crucial partnership which has given Portland its deserved reputation as a transportation innovator and a city that sets the standard for others dealing with the problems of urban growth. In this way, the NW 23rd project and the transit mall do not simply belong to the transit agency or to their respective neighborhoods, but to the city as a whole.

The viability of this approach for other streets, Tri-Met cautions, depends on many factors: current vehicle use, frequency of buses, number of transit riders and pedestrian usage, and the cost of construction. In addition, the size and the arrangement of amenities must be considered, as well, because this will influence how and whether or not bus passengers actually use them.

4.6 Case Study 4 -- Main Street Transit Shelters, Rochester, New York

Home to major corporations like Kodak and Xerox, downtown Rochester is a primary economic center for the region. Main Street is the spine of downtown Rochester as well as a major transit hub, where nearly all bus routes in the city converge. In addition to serving as a downtown destination, Main Street is a transfer point for thousands of riders each day. By the early 1980s, sidewalks on Main Street had become increasingly congested with transit riders as well as other downtown pedestrians. With construction of wider sidewalks, streetscape amenities and, most importantly, attractive new bus waiting areas in 1989, the environment on the street has greatly improved and passengers now consider their bus stops to be very "user-friendly."

Project Goals

The goals of the Main Street Pedestrian and Transit Improvement Project included

- Reducing pedestrian conflicts at bus stops;
- Alleviating the sidewalk congestion that was negatively impacting area businesses;
- Providing adequate sheltered waiting areas for peak-hour transit passengers who, for lack of an alternative, leaned against buildings and blocked store fronts and entranceways;
- Introducing bus shelters designed to reflect the character of the downtown area;
- Improving the perception of safety and actual safety for passengers and pedestrians in the downtown; and
- Correcting the imbalance between space provided for pedestrians and space dedicated to vehicles. (Pedestrian traffic, including waiting transit passengers, was considered more important than vehicular traffic to the economic health of the street, yet was afforded less room.)

Design Process

The Main Street Transit and Pedestrian Improvement Project began in 1976 as part of a downtown master plan that was completed that year. In 1978, the City of Rochester asked the transit authority for a concept plan outlining how transit should serve and be integrated into the downtown. The initial plan called for a transit-only mall flanked by covered sidewalks extending for several blocks on both sides of the street, but the local business community reacted strongly against it. Input from the business community, along with the dialogue about the future of transit in Rochester that it engendered, led to the development of a more refined planning and engineering process and, ultimately, the concept for street, shelter, and pedestrian improvements. All agreed that transit service should remain centrally located (on Main Street) and were in favor of pedestrian improvements that would solve congestion at stops. Wider sidewalks, for example, would allow free movement of passersby and provide adequate space for bus shelters large enough to accommodate groups of waiting passengers previously huddled against buildings.

Representatives of the R-GRTA visited other cities with transit malls, specifically Chicago, Illinois, and Portland, Oregon. The Rochester business community funded a visit by the Portland transit mall architect to Rochester to meet with the City, the transit agency, and local business people. The City hired consultants to reconfigure the street and sidewalks, locate the shelters, and select and site other amenities, such as flower planters, information kiosks, light fixtures, and benches. Part of planning for the Main Street redesign in 1983 included conducting surveys of area merchants, pedestrians, and transit users to identify their needs, concerns, and the most important features and elements to be incorporated into the plan. These improvements were constructed between 1987 and 1989.

Features

The R-GRTA settled on a custom-designed shelter that most closely resembled the shelters in use on the Portland transit mall (see Figures 9 and 10). The R-GRTA also decided that the City needed three different sizes of shelters, with the size determined by passenger volumes at each stop. The largest of these heated shelters (a necessity given Rochester's climate) -- aluminum structures mounted on curved granite bases -- are essentially small buildings that measure 40-feet wide and 100 feet in length and have Plexiglas roofs with tempered glass running along the sides and at the curved ends. These were installed at the largest transfer areas along Main Street, which serve about 40 bus routes. Like those in Portland, Rochester's shelters also include electronic bus arrival information, trashcans, incandescent lighting, benches, and telephones. In order to prevent undesirable use, seating was purposely limited, but leaning rails were provided inside and out. Adjacent to the shelters are large, open-air waiting areas with additional benches, shade trees, information kiosks, and planters.

On some streets intersecting Main, where sidewalks were not widened, less elaborate shelters were constructed, even though passenger loads warranted larger structures. These smaller shelters are unheated, have only one sidewall, are smaller in size, and have no seating.

A key component to the project was the agreement of the Main Street business community to form a benefit assessment district for Main Street that would fund maintenance and capital repairs for the entire project. Fees are based on proximity to and building frontage along Main Street and cover daily cleaning of all the shelters as well as ongoing repair.

Impacts

Ridership Impacts

Both the R-GRTA and transit customers are positive about the shelters and pedestrian improvement projects. Ridership has increased slightly compared to 1995, despite a 25% fare increase in April 1996. The system experienced an initial 8% loss of riders, which was offset immediately by an 8% increase in ridership by students. (The school district

pays for student fares.) In the agency's experience, ridership is also affected by service levels, social factors in communities, and the existence of development along transit corridors.

Passenger Perceptions

Surveys conducted for this study were compared with passenger and pedestrian surveys conducted in 1983 as part of the planning for the original Main Street redesign. At that time (before construction began), only 45% of passengers rated bus frequency and service reliability as good or excellent (up by 17% in 1996). Waiting conditions at bus stops were considered to be good or excellent by only 29% of passengers (up by 18% in 1996) and drivers as very courteous by 44% (up 22% in 1996). In 1983, 60% of transit riders said that the proximity of bus stops to downtown destinations was good or excellent; this number rose to 78% in 1996.

Success of the project also can be measured in terms of having solved such problems as sidewalk congestion due to the layout of bus stops and lack of passenger amenities: 62% of passengers surveyed on Main Street stated that the width of sidewalks and circulation space is good. Similarly, ease in walking to the stop was rated as good by 69% of passengers on Main Street. The project also has successfully provided a pleasant and effective waiting area near the curb for boarding and alighting passengers -- ease in boarding the bus was rated as good by 67% of riders on Main Street.

Pedestrian/transit patron conflicts still persist on side streets such as Clinton and St. Paul, where the sidewalk width was constrained by the number of travel lanes determined by the City's traffic engineers to be necessary at the time of redesign. At these heavily used stops, the sidewalks were not widened and the smaller transit shelters without seating that are provided do not work as well for passengers as do the full-sized shelters. Pedestrians must filter through the transit shelters in order to walk along the street. At these bus stops, only 47% of transit passengers surveyed rated the ease of walking to the stop as good. They also rated the overall waiting conditions at the Clinton Street shelters lower, with only 29% saying that conditions were good, compared to 60% of patrons using the shelters on Main Street. Width of sidewalks and circulation space were rated more often as fair (45%).

Part of the Main Street project evaluation included observations of whether or not passengers were waiting near the stop but not within shelters. While the project has generally achieved the goal of providing enough space for bus patrons so that they no longer block storefronts, one very heavily used bus stop was divided into two separate stops during the redesign. Unfortunately, most transit riders relocated to only one of these stops, which is too small to handle the volume of passengers who use it. Observations showed that only 50% of patrons waited within the designated bus waiting area (shelter and adjacent benches) while another 50% waited in front of the adjacent storefront and entranceway.

About 42% of passengers at the Main Street shelter rated protection from weather as

Figure 9. Interior of Main Street Transit Shelter, Rochester, NY

Figure 10. Bus Shelter, Main Street, Rochester, NY.

Figure 11. Bus Shelter, Clinton Street, Rochester, NY.

good, compared with only 17% waiting on the side streets (St. Paul and Clinton). Similarly, 43% of passengers waiting on Main Street rated the cleanliness of these shelters as good, as compared to 15% waiting at the smaller shelters. Lighting also was considered to be better at the larger shelters, with 49% of passengers rating this as good and only 21% citing side street shelter lighting as adequate.

The design of the shelters does seem to have had an impact on people's decision to ride the bus: 40% of the surveyed passengers waiting at the shelters on Main Street agreed that the design of bus stops make them more likely to use transit (as opposed to 26% of patrons waiting at the smaller side street shelters) and 41% said that they are more likely to recommend riding transit to a friend (versus 31% at the smaller shelters). In general, passengers surveyed at the smaller shelters along St. Paul and Clinton streets had more suggestions for how to improve their shelters than did passengers waiting on Main Street. For example, these passengers wanted their shelters to be improved with heaters, seating, better weather protection, more schedules, cleaner sidewalks, more waste receptacles, and better lighting.

Maintenance Impacts

In general, the shelters on Main Street are well maintained and well respected by the public. Any vandalism or breakage is immediately repaired. The downtown benefit assessment district funds maintenance and capital repairs for the entire project and pays for daily cleaning of all the shelters as well as ongoing repair. An R-GRTA official cautions other transit agencies that quality maintenance may be key to the success of a project: "if you're not prepared to maintain it, don't do it. If community expectations have been raised to a higher level and you don't keep it up, the community loses respect."

Costs

The project was funded largely with federal transit dollars. In 1984, $18.5 million in federal and state transit money was granted to the City for construction and implementation. Rochester also received a block grant (now Section 9 formula aid), and Section 3 discretionary money was committed by the Federal Transit Administration. The project qualified for this FTA money because it had bi-partisan and public/private support. Of this investment, about 25% went to pay for the shelters. The 19 full-sized shelters cost $250,000 each to build, complete with all of the amenities.

Conclusions

Building upon the cooperation among the transit agency, the City, and the business community, Rochester's Main Street now provides a much-improved environment for transit riders and pedestrians alike. This renewal has been achieved without negatively impacting automobile traffic and has made transit operations more efficient. Still, problems with specific bus stop locations remain which need to be addressed. Moreover, a new revitalization strategy is required to build upon the success of Main Street and take advantage of the attractive setting that has been created.

4.7 Case Study 5 -- Historic Streetcars on Market Street, San Francisco, California

In 1995, the San Francisco Municipal Railway (MUNI) introduced historic Presidential Conference Committee (PCC) streetcars into regular service on Market Street in downtown San Francisco. To create the new F line, San Francisco purchased and restored PCC cars, many from other cities where, ironically, they had been taken out of service as outmoded vehicles.

Though not modern in design, the streetcars have become, in a very short time, a beloved community institution as well as viable transit vehicles. While having to accept the features of the streetcars as given, MUNI has discovered that the 1930's design, innovative in its day, still has strong customer appeal. Ridership has even doubled compared with the bus line that previously serviced the same route.

Project Goals

In 1973, the City of San Francisco adopted a "Transit First" policy that gives public transit priority over automobiles on city streets. This signaled the start of the incremental reclaiming of Market Street by transit, reversing an auto-oriented plan implemented in the 1960s.

A key goal of this project was also to alleviate overcrowding on the underground subway lines and provide more efficient local service than was available on the slower, less efficient Market Street buses. However, MUNI also sought to increase ridership by doing something special with transit service on San Francisco's "main street," something that would create a strong public identity. Using the inspiration of the popular, experimental use of historic streetcars for festivals, MUNI developed a permanent service, intentionally *not* choosing to build new light rail vehicles.

This initiative, which necessitated rebuilding the street to accommodate the streetcars, was able to address community goals in the distinctive Castro District, the end terminus of the F Line, as well. At the outset of the project, the community and local businesses voiced their desire to make Upper Market Street in the Castro District more attractive by upgrading the street median, introducing a dedicated bicycle lane, and adding landscaping and streetscape improvements. Thus, the Market Street Transit Thoroughfare project combined development of the streetcar right-of-way with additional pedestrian and traffic improvements.

Design Process

In the early 1980s, Market Street Railways, a private non-profit firm that purchases and restores vintage streetcars from around the world, approached MUNI with the idea of holding a historic street car festival on summer weekends, featuring restored streetcars running along existing (but deteriorated) tracks on Market Street. The success of the historic streetcar festival and the added transit service it provided convinced city leaders

to restore regular streetcar service to Market Street, using historic streetcars rather than new light rail vehicles.

MUNI selected PCC cars, dating from the 1930s and 1940s, because they were available in large numbers at the time discussions about Market Street were taking place: Market Street Railways had fifty PCC cars in storage. In addition, MUNI had operated PCC cars up until 1978, had years of experience with them, and a knowledgeable staff who touted their reliability. The only other option that was considered was building new streetcars and making them look old. This option was considered to be too experimental with too many unknown factors, including cost.

Those involved in the design of Upper Market Street included the Mayor's Advisory Committee on Upper Market Street, the Department of Public Works, community groups, including a coalition of bicycle advocates, the San Francisco Municipal Railway, and area merchants. During the conceptual design stage in the mid-1980s, MUNI invited the community to participate in discussions regarding F Line alignment, location of stops, and the terminus.

Features

A fleet of 17 PCC streetcars has replaced electric trolley buses (which served the same route) and now travel in a mixed traffic lane along a newly rebuilt Upper Market Street, which features a bike lane as well as a median planted with Canary palm trees. Completed in 1995, the F Line extends to Lower Market Street and will eventually continue to Fisherman's Wharf along the Embarcadero, San Francisco's waterfront (see Figure 12).

The PCC cars (see Figure 14) have been completely restored and are kept very clean. Their interiors include well-padded seats and handholds and are attractively painted in pale yellow and green. The cars are not air-conditioned, but have natural ventilation. Lighting is incandescent.

The exterior of the cars are rendered in different color schemes, corresponding to the original colors of the livery service in cities across the country that ran PCCs in the 1940s through the 1960s, including Pittsburgh, Cincinnati, Brooklyn, Los Angeles, Boston, Philadelphia, Chicago, and Washington, D.C.

New transit boarding islands and attractive medians have been constructed on Market Street, enhancing the line's identity. The boarding islands have been constructed to be wheelchair-accessible and feature a permanently installed ramp to raise passengers to the height of the streetcar. Streetcar conductors then unfold a portable metal ramp (which they store behind their seat) which bridges the gap between the ramp and top step of the streetcar. Some islands are outfitted with leaning rails, simple shelters, and flip-down seats, while others have only leaning rails. Plaques containing poetry were commissioned by the San Francisco Art Commission and are embedded in the boarding islands all along Market Street.

Impacts

Ridership Impacts

The Market Street Thoroughfare Project improvements and the PCC streetcars have helped strengthen the presence of transit on the street. Because of their unique design, the streetcars are highly visible, and the careful design of the street allows them to function efficiently. Ridership has nearly doubled, from 5,000 to 9,000 boardings per day, compared with the previous trolley coach serving the same route.

At the same time, however, overall MUNI ridership has fallen 6% since its peak in 1989 due to several factors. BART has absorbed some passengers because of a change in fare structure, demographic changes citywide have shown that transit-dependent people can no longer afford to live in San Francisco proper, and the city's increasingly affluent residents drive cars. In addition, MUNI experienced budget cuts in the early 1990s that forced it to cut service, and it lost riders as a result.

Passenger Perceptions

Nearly all passengers surveyed for this study at the F Line stop adjacent to the Castro Street MUNI subway entrance, who had a choice of taking the F Line or the MUNI subway, reported choosing the F line because the streetcar is more comfortable, less crowded, and more charming. Also, in another survey, three-quarters of pedestrians said having streetcar service and stops on Upper Market Street makes them more likely to take transit, and 20% of those surveyed had used the streetcar to reach the street that day.

According to passenger surveys conducted on board both the F line street cars and the buses (see Figure 13) which travel Market Street, streetcar passengers rated their vehicle higher than bus passengers in every category (attractiveness, overall comfort, lighting, safety, comfort and amount of seating, cleanliness, smoothness of ride, availability of schedule, and route information). Furthermore, three-quarters of streetcar passengers said that because of the vehicle's design features, they are more likely to take transit. Two-thirds said that the design features make them more likely to recommend that their friends take transit as well.

Transit passengers surveyed aboard PCC streetcars had some suggestions for improvement to the vehicle. They mentioned more seating and handles for standees, more legroom, increased frequency of service, and the addition of more vehicles to the F Line. In addition to suggesting more seating, passengers on the Market Street bus cited better cleanliness, improved ventilation, more circulation space, smoother ride, and better lighting as needed improvements.

Transit Boarding Islands

Passengers were also surveyed at the transit stops about their perceptions of the waiting environment amenities. The transit boarding islands were described as functional, but

Figure 12. F Line PCC Streetcar, Market Street, San Francisco, CA.

Figure 13. Trolley bus, Castro Street, San Francisco, CA

Figure 14. F Line PCC Streetcar interior, Market Street, San Francisco, CA.

offering few amenities such as seating and shelters. Focus group participants commented that they appear to have been selected out of a catalogue rather than chosen to complement the historic streetcars and streetscape design. Furthermore, the leaning rails are too high for comfortable leaning. Of passengers surveyed at F Line stops along Upper Market Street, 67% rated their transit stop "good" for overall attractiveness, but only 43% "good" for overall comfort. Half of the respondents questioned wanted improved shelters with walls and a roof, as well as route maps and schedules at transit stops.

Maintenance Impacts

MUNI found that PCC cars are easier to maintain than the newer, more complicated light rail vehicles and travel many miles between repairs; they have also allowed for standardization of the fleet. Operating costs increased over the bus which served the same route, primarily due to increased accidents with cars because of increasing automobile traffic and the fact that the streetcar does not travel in a dedicated lane. In addition, growing traffic volumes on Market Street have forced the line to run more slowly and this, coupled with heavy demand, has forced MUNI to put more vehicles into service, which raised operational costs as well.

Providing access for passengers with disabilities is not costly. It proved relatively easy to provide access for passengers with disabilities to these vehicles and, unlike vehicles with wheelchair lifts, the streetcar's simple ramp system rarely needs repair.

The streetcar operators are a self-selected group, people who like the streetcars or the route and enjoy interacting with people. The F line car maintenance plan requires all drivers to perform minor daily maintenance, which means that any vandalism or graffiti can be removed the same day, thereby enhancing the streetcars' cleanliness and image. "Before leaving the station, the drivers check for cleanliness and damage, and they want to bring it back in the same condition. MUNI tries to instill this approach in its drivers," explained a focus group participant. The system of involving drivers in maintaining the F Line streetcars is being introduced for operators of new light rail vehicles and buses as well.

Costs

The total cost of the Market Street Transit Thoroughfare Project was $50 million. This work was funded by a half-cent tax for transportation improvements collected by the San Francisco County Transportation Authority, FTA Section 9 grants, and state Guideway funds.

Half of the costs were for non-transit-related street improvements, such as utilities, sidewalks, street trees and furniture, reinstalling of light poles, and reconfiguring the street. The other half was dedicated to transit elements: the F Line track, the streetcars (including retrofitting them to meet ADA requirements), and boarding islands. The PCC cars in regular use were purchased by MUNI in 1991 and renovated at a cost of $700,000

per vehicle. International vintage streetcars continue to be purchased, restored, and turned over to MUNI by Market Street Railways, which continues to raise funds for this purpose.

Conclusions

The general consensus is that the project was good for transit, the city, and the community. The F Line streetcars are becoming as well known as the cable cars, at least among San Franciscans, and have contributed to a new image for the Castro neighborhood. That transit ridership has nearly doubled compared to ridership on the bus line it replaced also demonstrates public preference for a quality product and service.

CONCLUSIONS

The planning tool developed for this study -- the Transit Design Game survey and software -- along with the case studies of implemented projects, literature reviews, and interviews, clearly demonstrates the impact that passenger amenities and vehicle design characteristics have on shaping people's transit ridership choices and how these features can increase ridership. There remains, however, much more to be learned.

The Transit Design Game tests for a representative but limited type and range of fairly widely available transit features. To be completely effective, the Game should be adjusted by participating transit agencies to test for features appropriate to their cities – that is features that they would really consider providing, such as shelters with shade trees or cool towers in hot climates instead of shelters with heat. Only in this way will a feature's true value to a patron in certain climates or regions become clear.

In addition, while this study focused on bus stops and vehicles, more research is needed into rail (light, heavy, commuter) transit, particularly with regard to passenger amenities on rail vehicles and at rail stations. Buses and bus stops represent comparably modest investments on the part of a transit agency, vis-a-vis rail vehicles and facilities, which are many times more costly to purchase and to upgrade. Modifying the Transit Design Game to be used by rail transit agencies when planning station and amenity upgrades would be a logical next step and helpful in directing investment where it matters most to transit riders.

The case studies and Cases in Point presented in this Handbook demonstrate that much can be, and already has been achieved, even given limited budgets and resources. Quality amenity programs require a different way of doing business for a transit agency, one that involves the customer in helping to make decisions about service and facilities. It should also be emphasized that the most successful amenity programs projects were those in which partnerships were created among transit agencies, other city agencies, state and federal government, local merchant and community groups, and equipment manufacturers and designers to accomplish more than the transit agency could by itself.

We hope that this Handbook and the Workbook that accompanies it will help encourage other transit agencies to work with their customers in shaping future amenity programs to draw new transit riders, improve the experience for existing customers, and, ultimately, to make transit a part of everyone's daily life. As more agencies test the Game, more information will be revealed in terms of how amenities affect transit choice and impact existing and potential transit customers.

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