Study of Park-and-Ride Facilities and Their Use in the San Francisco Bay Area of California

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Study of Park-and-Ride Facilities and Their Use in the San Francisco Bay Area of California

Manish Shigaokar and Elizabeth Deakin

Park-and-ride lots are important support facilities for transit and ride-sharing in the San Francisco Bay Area of California. The authors designed and carried out the region's first large-scale, detailed study of park-and-ride facilities and users. Three Bay Area Rapid Transit (BART) station parking lots were also surveyed. The user survey results showed that almost all the parking users were commuters, at the freeway lots, half were transit users and the remainder were organized and casual carpoolers. Most drove alone to the park-and-ride lot and made long trips to work, many more than 30 minutes. Users had concerns about lot security, the lack of lighting, and the quality of transit services offered. Analysis of focus group data determined that schedule adherence rather than frequency was the cause of most concerns. Participants expressed a willingness to pay for parking that was fenced, security patrolled, and lighted, with shelters for waiting. Together, the surveys and focus groups have provided insights into ways to improve the park-and-ride lots and the services offered there, as well as on how travelers view transit and carpooling options. The results provide a sound basis for planning improvements.

Park-and-ride lots serve an important function in supporting travel by transit and carpool in the San Francisco Bay Area of California. Since the 1970s, the California Department of Transportation (Caltrans) has owned or leased parking facilities along freeways throughout the region, with the current inventory totaling 5,017 spaces in 49 lots, as shown in Figure 1. Additional park-and-ride lots are owned by cities and counties, especially in the South Bay. More than 100 bus lines run within 1 mi of the park-and-ride lots, as shown in Figure 2, and most of them serve these park-and-ride facilities, offering express or limited stop services to major employment centers and intermodal hubs. One hundred and three (74%) regional express bus routes run within 1 mi of a park-and-ride lot; 80 (83%) park-and-ride lots are within 1 mi of a regional express bus route. Further, rail transit and ferry operators provide park-and-ride lots and garages at many of their suburban stations. Bay Area Rapid Transit (BART), the rail transit provider in the region, for example, owns more than 47,000 parking spaces.

Over the past few years, a number of issues have arisen concerning the supply and operation of park-and-ride facilities. Some lots are oversubscribed, with parking spilling over into nearby retail parking lots or onto residential streets, while others are nearly empty. Finding sites to expand surface parking, or the funds to build structures, is not an easy task. Some decision makers question the advisability of park-and-ride expansion, favoring instead the development of transit-supportive land uses, bus and paratransit feeder services, and pedes tria and bike access. For example, the board of BART recently adopted policies that encourage higher-density land uses near its stations in an effort to stimulate pedestrian trips to the station and to reduce the use of the automobile for BART access. However, to support ridership on its system in outlying suburban communities, BART continues to expand parking at some stations.

Most parking is currently provided for free in the region, and whether to charge for park-and-ride spaces has also become a policy issue. BART has adopted parking charges at some of its most heavily used stations, in part to deter use of BART parking by nonriders. Alameda–Contra Costa Transit District (AC Transit), a major bus operator in the region, recently adopted a policy that will impose parking charges at certain park-and-ride facilities to cover costs of operation and maintenance.

PARK-AND-RIDE TOPIC BROUGHT TO FOREFRONT

Recent proposals to expand the Bay Area's high-occupancy vehicle (HOV) system and to increase express bus services have brought the park-and-ride issues to the forefront. Running express buses on freeway and arterial HOV lanes would both increase the throughput of these lanes dramatically and provide a fast, efficient transit option to many parts of the region. In some cases, express buses could serve as a substitute for rail or ferry parking expansion, providing a convenient access option for rail users. In other cases, express buses could serve as peak-hour supplements to overtaxed rail lines. In still others, express buses could serve as an interim option, offering a test of the market for transit before rail or ferry services are implemented. Overall, express buses could go a long way toward improving travel alternatives—but for many of the issues, park-and-ride issues will have to be resolved for the express transit service to be successful.

Park-and-ride is also a critical component of the region's ridesharing programs. In several corridors of the Bay Area, ridesharing includes not only formally organized, prearranged carpooling and vanpools, but also casual carpools, in which drivers pick up riders on an as-available basis at various locations around the region, sharing a ride to make use of HOV lanes and toll-free bridge crossings. Indeed, many park-and-ride lots contain substantial shares of formal and informal ridesharing patrons, and some of the parking capability at BART is also used by poolers, some with official sanction and some without it.
FIGURE 1 Caltrans-owned park-and-ride lots in the San Francisco Bay Area.
Despite the many issues that have been raised about park-and-ride lots in the Bay Area, there is remarkably little data on who uses these lots. Data were available for a few locations because of special studies done there, but no overall survey of park-and-ride users had been done in the region. Caltrans conducts biennial occupancy counts and produces an overview conditions analysis of its lots, but it does not carry out counts at park-and-ride lots owned by others, nor does it conduct user or conditions surveys. BART conducts periodic parking and platform surveys, but the most recent detailed data are from 1996 and are becoming old. Hence, the authors designed and carried out the first large-scale, detailed study of park-and-ride facilities in the Bay Area.
Two types of park-and-ride facilities were studied. The majority were park-and-ride lots used by both express bus and carpool commuters. Most of these park-and-ride lots are owned by Caltrans, but a few are county, city, or bus operator. These lots are located along major freeway corridors in the region. Also, there was a survey of three of BART's 32 station lots, with the use of a slightly modified survey form. All three are major intermodal transfer stations, and one allows a limited amount of carpool parking.

**Methodology**

Three methods were used to assess park-and-ride issues and options. First, an occupancy and site survey was conducted at all Caltrans-owned park-and-ride facilities in the region. Second, user surveys were carried out at 35 parking locations. Finally, focus groups were conducted, at which park-and-ride issues raised by the site surveys and user surveys were explored in depth.

The occupancy and site survey was done in partnership with Caltrans District 4 staff. The authors designed and piloted a field survey document that allowed them to record numbers of spaces, occupancy, and conditions on and around the site. That layer of data gathering was followed up by trips to the parking locations, after which the conditions were cataloged in photographs, a process that supplemented the data gathered.

For the user survey, the authors worked with the study's Technical Advisory Committee (TAC), which has representatives from transit operators and congestion management agencies. That group helped to identify a sample of parking lots that were heavily subscribed or had substantial transit service, or both. A mix of Caltrans, city, county, and transit agency lots was recommended for the user survey. In addition, BART staff recommended three BART stations with extensive park-and-ride and also substantial amounts of feeder bus service for surveying. A total of 32 Caltrans and other lots and three BART station lots were surveyed. Together these lots contained 13,421 spaces of which 11,811 were occupied on the survey day. A survey was left with each of the 11,811 vehicles observed. The authors surveyed 49% of the total Caltrans park-and-ride lots in the region, accounting for 59% of the total Caltrans parking spaces. Of the 32 BART station parking lots, three were surveyed, which accounts for 18% of the 47,036 parking spaces at BART stations throughout the region. Also surveyed were 10 other city-, county-, or agency-owned lots. Of some of the lots, the TAC helped identify overflow. From that feedback, surveys were distributed along specific streets surrounding the parking lots.

For the selected lots, a two-page 25-question survey instrument was developed. A few questions were altered for the BART survey to make it more focused for rail transit users. The survey instrument was reviewed by the TAC and was then pretested and refined.

The survey was color coded and numbered to indicate the park-and-ride lot being surveyed, and a cover letter from the owner of the lot was attached, along with a prepaid postage return envelope. These materials were then placed under the windshield wiper of every vehicle in the selected lots. Survey distribution was done between 10 a.m. and 2 p.m. on weekdays—days when the lots were at their maximum use. The surveys were distributed in April and May 2004.

Survey responses started arriving almost immediately after distribution began. Between May and August 2004, the authors received 35% (N = 1,209 of 3,685 surveys distributed) of the "Caltrans/other lot" responses and 32% (N = 2,469 of 8,126 surveys distributed) of the "BART station lot" responses. Table 1 shows the return rates by lot and corridor. The responses were coded by using Microsoft Access, and the analysis presented in this paper was performed with Microsoft Excel. For some analyses, the lots were aggregated by corridor and subregion, and the results are presented in the following categories: I-80, US-101 N, US-101 S, I-880, East County (consisting of I-880, SR-4, and I-880), and BART (station lots). These corridors have different transit levels of service and different demographics, so the differences and similarities among corridors are policy relevant.

The sample size is sufficiently large that the authors are 99% confident that the projected results are within 1.6% of the true value in the population. For example, if it is shown that 50% of respondents are female, the authors are 99% confident that the true female share within the total parking population in the Bay Area is between 49.2% and 50.8%. For individual corridors, the results presented are in the 98% to 99.5% confidence level.

Focus groups were designed to follow up on issues raised in the survey and the user survey. Focus groups are not intended to provide a statistical sample but rather to provide for in-depth dis-

<table>
<thead>
<tr>
<th>Corridors and Their Counties of Location</th>
<th>Number of Spaces</th>
<th>Number of Surveys Distributed</th>
<th>% Occupancy</th>
<th>Number of Responses</th>
<th>% Response Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>US-101 N (Marin and Sonoma Counties)</td>
<td>1,317</td>
<td>1,209</td>
<td>92</td>
<td>414</td>
<td>34</td>
</tr>
<tr>
<td>US-101 S (San Mateo County)</td>
<td>240</td>
<td>36</td>
<td>15</td>
<td>9</td>
<td>22</td>
</tr>
<tr>
<td>I-580 (Contra Costa and Solano Counties)</td>
<td>1,687</td>
<td>1,575</td>
<td>93</td>
<td>540</td>
<td>34</td>
</tr>
<tr>
<td>East County (I-880, SR-4, I-800) (Contra Costa and Alameda Counties)</td>
<td>1,008</td>
<td>755</td>
<td>44</td>
<td>200</td>
<td>39</td>
</tr>
<tr>
<td>I-880 (Alameda County)</td>
<td>116</td>
<td>112</td>
<td>97</td>
<td>36</td>
<td>32</td>
</tr>
<tr>
<td>All park-and-ride lots</td>
<td>5,038</td>
<td>3,625</td>
<td>73</td>
<td>1,289</td>
<td>25</td>
</tr>
<tr>
<td>BART station lots (5 lots of 32 with parking)</td>
<td>8,355</td>
<td>8,126</td>
<td>57</td>
<td>2,019</td>
<td>32</td>
</tr>
</tbody>
</table>
cussions of key issues, in particular the underlying reasons for participants' choices and preferences. In a focus group, the manner of tone of voice, facial expression, and body language add to the understanding of oral responses. Seven focus groups considered park and ride as part of a broader discussion of commuting issues. One hundred people participated in those groups.

SURVEY RESULTS FOR OCCUPANCY AND CONDITIONS

Occupancy and conditions surveys were conducted at all 49 Caltrans-owned park-and-ride lots in the region. Of the lots, 19 (39%) were at or approaching capacity—that is, 80% full or more, with 13 at or over capacity (all spaces taken, cars parked on shoulders, etc.). Also, 11 lots (22%) were heavily used—between 50% and 80% full, and 19 lots (39%) were underused—that is, they had less than 50% occupancy at midday.

Conditions observations covered lot cleanliness, security, lighting, and amenities available, as well as conditions within walking distance (generally 1/2 mi, unless there were obvious barriers to walking that far) along the access roads to the station—such as street design, traffic levels, bike and pedestrian accessibility, transit services available, and shopping and services opportunities nearby. The observations provided information on why some of the lots were underused. Most of those lots were located away from the freeway and several blocks off the mainline transit route. Some were in isolated locations with no active land uses nearby. However, for both the used and the underused lots, some common problems were identified. Few of the lots had security patrols, and some showed clear signs of vandalism, for example, broken glass and spray-painted markings. Several had no sidewalk access and no bike lanes or bike parking. Many lacked bus shelters and signage on transit, and ridesharing services were minimal. Most lots lacked toilets, and some had vending machines or kiosks for beverages, snacks, or newspapers.

RESULTS OF USER SURVEY

The user survey results provided a clear picture of who was using the park-and-ride facilities that were studied, as well as their travel patterns, modes of travel, travel times, and user satisfaction. As noted earlier, the survey results are presented by corridor or subarea of the region, each reflecting the different services and demographics.

User Characteristics

Information about the respondents to the park-and-ride surveys was compared with data for the region as a whole. Regional data are taken from Census 2000 statistics reported for the overall San Francisco-Oakland-San Jose, California Consolidated Metropolitan Statistical Area and from BART's analysis of the same data. Findings point out that the sample, with slightly more females than males, is primarily made up of individuals with full-time employment, who are slightly older than the regional average.

Though the Bay Area is ethnically diverse, minorities are more prevalent in some corridors than in others. For example, there was a majority of white-Caucasian respondents in the sample along US-101 N (Marin County). In contrast, along I-80 north of Oakland and Berkeley, there were more black-African-American respondents than elsewhere. People of Hispanic-Latino ethnicity are underrepresented in the sample. Education is somewhat higher than the regional average, with most of the sample college educated.

Most park-and-ride survey respondents have more than one vehicle in running condition and available for use within the household. Regionwide, 57% of the population has more than one vehicle, making the sample more mobile than the population. Respondents from suburban areas—East County, I-880, and US-101 S—have the best transit and transportation workplace benefits, whereas I-80 respondents tend to have the worst benefits on a corridor-by-corridor comparison basis (see Figure 3). In relation to the reported ethnicity and education levels, the data show that the lower-income groups are paying the most for riding transit or have fewer benefits, or both, than their more affluent counterparts.
Travel Patterns

Almost all park-and-ride users are commuters. Nearly all (98% to 100%) began their trip at home, and nearly all go to work (94% to 97%, depending on corridor). The survey asked respondents to give street addresses or zip codes, or both for their origin-destination (O-D) locations. These data were geocoded to create desire line maps by parking location. The O-D patterns show that trips originate from all over the region, but major destinations are few. For example, at the freeway park-and-ride lots, 63% of the respondents are inbound to San Francisco. From the BART respondents, 70% are inbound to San Francisco, and 19% to Oakland.

Departure Time

As a group, park-and-ride users are early risers, but there are large differences between how early in the morning parkers leave in different corridors. The largely middle-class I-80 park-and-ride users leave much earlier than those in other corridors and groups. It was found that 56% of the I-80 park-and-ride lot users depart for the lot between 4 and 6 a.m., versus a mere 11% who report leaving that early in the affluent US-101 N corridor. BART parkers also travel somewhat later than average, with 21% leaving between 4 and 6 a.m. and 66% leaving between 6 and 8 a.m. Affluence is correlated with later departures.

Automobile Use

Almost all park-and-ride users (93% to 100% of the respondents) said they reach the park-and-ride lots by driving alone. Only 4% to 7% rode with someone else and parked or used another means of travel. However, because the survey was deposited on windshields, this method does not count those who walk or bike to the park-and-ride facility or those who are dropped off. In a separate onboard transit survey, it was found that a substantial number use those modes to reach the park-and-ride facility. They use the lot, but they do not park a car there.

Frequency of Use

Park-and-ride survey respondents are habitual users of the particular lots where they were contacted for the study. Between 67% and 95% of users (depending on corridor) park and ride 4 days a week or more. 89% to 100% (depending on corridor) reported that they park in the same parking lot at least 2 to 3 days a week.

Most users do not park at other locations. On the days that they do not park and ride, they either drive to work or work at home. However, 27% along US-101 N and 21% of the BART parkers said that they did park elsewhere some of the time. Comments provided on the surveys, field observations, and focus group discussions indicate that many of the patrons who use different lots do so because their preferred lot is sometimes oversubscribed.

Travel Modes to Destination

The mode of travel to the final destination varied greatly among corridors and groups, as shown in Figure 4. Along US-101 N, 86% of the park-and-ride survey respondents took a bus to their destination. Their only other option in this corridor would have been to carpool. In contrast, carpooling was the dominant mode in other corridors; only 36% of I-80 park-and-ride users and a mere 28% of the East County park-and-ride users took a bus to work. I-80 has the highest carpool rates (62% prearranged plus casual), followed by the East County corridors (54%). In comparison, only 12% of US-101 N respondents were poolers. The transit usage rate tracks two transit characteristics: high frequency of service, and direct, door-to-door service rather than transfers.

When asked how patrons traveled to their destinations from the parking lot, as might be expected, a majority (97%) of the BART patrons said they got onto BART trains. Yet 3% admitted using the
BART itself, but not BART lot. BART allows carpools at one of the surveyed stations (Pleasant Hill), yet the share of casual or prearranged carpools at that lot was not any different from that at the other two BART lots.

A large percentage of users in each corridor and group either gets dropped off directly at their destination or walks to their final destination, as shown in Figure 5. A partial exception is in the East Bay corridors, where sizeable shares of parking users transfer to another mode of transit (BART, bus, etc.) and then walk to their final destinations.

**Return Travel**

Most BART park-and-ride users commute in both directions by BART, and most transit users who park at the other parking lots also use transit for their return trip, as shown in Figure 6. Mode shift is apparent, however, among the carpools in the East County corridors, 54% of whom carpool in the morning but return on transit (see Figures 4 and 6). Many of these mode-shifters are casual carpools, for whom the return trip by casual carpool is more difficult than the morning trip.
Travel Times to Park-and-Ride Lot

Most parkers live fairly close to the park-and-ride lot they use, with 70% within a 10-min journey to the lot. BART for users traveled somewhat farther, with only 48% of BART station users within 10 min of home. Average travel time from point of origin to parking location for BART station lot users is 16 min; for the other corridors and groups, it is 11 min.

From the parking lots, the average travel time to destination is 42 min, but that varies substantially with the corridor. Few parking users reach their destination in less than 20 min. A few corridors have trips longer than 1 h, for example, the highest at 23% in US-101 N. The average door-to-door travel time is 53 min, and it is slightly higher for the more affluent US-101 N (60 min) and BART (59 min).

Average return times are longer than arrival times—the average time slipping from 42 min inbound to 48 min on return, with I-80 going from 43 min in the morning peak period to 53 min in the afternoon peak period. All other corridors also show deterioration in average return times.

User Satisfaction

The survey included a series of questions in which the respondents were asked to rate the park-and-ride facilities they used on the basis of lot location, space availability, transit service frequency, and transit service quality. It is typical for responses to such questions to be quite positive; as research in psychology has long demonstrated, people reduce stress and emotional conflict by concluding that they are reasonably happy with the choices they make and the conditions in which they must conduct their daily lives. Hence, substantial percentages of negative comments are generally a more telling indicator that are substantial percentages of positive responses. If more than one in 10 respondents reported a negative on a rating question, it was chosen to be reported here.

Satisfaction with space availability varied on the basis of corridor, even when actual space availability statistics were similar. For example, 40% of I-80 parkers were dissatisfied with parking space availability, whereas along East County corridors, most respondents were satisfied with a similar level of parking availability.

One-fifth in each corridor also thought that transit service frequency needed to improve. Notably, carpolees were as likely to be dissatisfied with transit service as were transit users. Long headways and transfers were the most disliked features of existing transit services. Comments on the surveys show that many want direct service—bus or rail—to San Francisco, Oakland, or Berkeley rather than a timed transfer from bus to rail. One person in 10 was dissatisfied with the transit destination served and an even smaller number was unhappy with in-vehicle speed, comfort, or convenience.

Almost one-half (48%) of I-80 parkers believed that the safety and security of the parking lots needed to improve. Nearly one third of the I-80 park-and-ride users (36%) had concerns about the park-and-ride lot as a place to wait. Exhaustive comments by users focused on the following needs: patiends and security, lighting, more parking, bathrooms, and cleanliness. In other corridors, the same issues were raised, but the percentages of respondents raising them were somewhat lower.

Summary of Key Findings

The survey showed that park-and-ride users were almost entirely commuters who worked full time and used the same park-and-ride lots for at least four or more days a week. Demographically, park-and-ride users were fairly typical of the region’s workforce. However, their incomes were highly varied by location and commute mode. As is the case with the workforce as a whole, commute-level income differences were strong, with Marin and East County park-and-ride patrons far wealthier than commuters along the I-80 corridor (reflecting subarea differences in incomes).

Of those who reported their primary travel mode to work, 82% used transit, while the remaining 18% carpooled or used other means. Large differences by corridors reflected the amount of direct transit service available. Along US-101 N, most commuters were heading for San Francisco and many could take a bus directly from home to their destination, only 10% used prearranged carpools, and just 2% used casual carpools. In contrast, the number of carpolees was highest in the I-80 corridor and in East County, both locations where there is limited direct transit service. It was found that 29% of the I-80 travelers and 25% of those from East County used prearranged carpools, and an even higher share were casual carpolees (33% of I-80 and 29% of East County).

Park-and-ride users were using transit or ridesharing by choice. Almost all had a valid driver’s license and more than one vehicle in running condition available to the household. Most drove alone to the park-and-ride lot. Further, most were making relatively long trips, with an average door-to-door inbound travel time of 53 min. Those travel times imply trip lengths of 30 mi or more.

Almost all park-and-ride users of BART and other, chose the lot closest to home. About 70% of parkers traveled 10 min or less to reach their park-and-ride lot; patrons of the three BART lots surveyed traveled a bit longer. Most used the same lot routinely. Less than some distance from the freeway or that have limited transit service, or both, were underserved even when the more convenient and heavily served lots were oversubscribed. It appears that, in most corridors, park-and-ride users would rather drive to work than use a poorly located or poorly served parking lot.

Many park-and-ride users also were early travelers (before 6 a.m.), especially those of moderate income. More affluent workers traveled somewhat later. Early departures were partly done to ensure the availability of a parking space in the park-and-ride lots, but for many workers, the early starts were necessitated by the long distances they traveled (many trips starting before 6 a.m. are 30 mi or more in length).

FINDINGS OF FOCUS GROUPS

The findings from the conditions surveys and user surveys were used to identify a number of issues to discuss with focus group participants. The authors wanted to discuss participants’ concerns about the park-and-ride lots and the services available from them, to understand better why particular lots were not used, to discuss participants’ views on the importance of various park-and-ride lot attributes and design features, and to explore patrons’ willingness to pay for parking.

For nearly all focus group members, the park-and-ride lots used was the one closest to home that also had the transportation services they wanted. Some did bypass a close lot for a more convenient and comfortable one. For example, focus group members believed that some lots were not good locations for casual carpooling, or they were a long way off the freeway, such lots were deemed less desirable. When they had a choice of lots, many travelers chose the one with the highest transportation service frequency or that required a lower amount of hassle, for example, having to drive through congested traffic to get to the lot was a large negative. Women looked for lots that were
CONCLUSIONS

The findings confirmed that park-and-ride lots need to be discussed as part of any policy dealing with the growth of transit in the San Francisco Bay Area. These facilities are widely used by different demographic groups around the region, and they are in dire need of maintenance and upgrades. The rating questions as well as focus group discussions pointed to the need for making parking lots safer, well lit, and comfortable places to wait. Cleanliness and the lack of security were mentioned as issues that need to improve. Many lots are overcrowded or fast approaching capacity, and there is a need to come up with new ways to increase parking supply.

Surveys of park-and-ride facilities and users have provided many insights not only into ways to improve the park-and-ride lots and the services offered there, but also on how travelers view transit and carpooling options from those lots. By combining facilities surveys, user surveys, and focus groups, the authors were able to develop a in-depth understanding of user interests and concerns. The resulting information base will provide a sound basis for planning improvements in park-and-ride lots and transit services; the surveys and procedures can be repeated from time to time to develop a progressive and responsive planning approach for these services. The methods and issues stemming from this Bay Area study should provide a good framework for studies in other metropolitan regions.

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