The CarLink II Pilot Program: Testing A Commuter-Based Carsharing Model

Transit Applications

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Abstract-- The automobile is the dominant travel mode throughout the U.S., while transit accounts for less than four-percent of market share. Between these principal modes, niche markets exist for other transportation services, such as transit feeder shuttles and carsharing. Commuter-based carsharing, in which individuals share a fleet of vehicles linked to transit, could potentially fill and expand one such niche, complement existing services, and develop into an economically viable transportation alternative. While most transit shuttles rely heavily upon governmental support, carsharing has the potential to become commercially sustainable.

In 1999, the first U.S. smart commuter-based carsharing program—CarLink I—was launched in the East San Francisco Bay area. Positive program response led to the development of CarLink II—a larger, more in-depth exploration of the commuter model. Program differences include: an increase from 12 to 27 vehicles; a shift from one employer to many; a move from the Dublin/Pleasanton region to the South San Francisco Bay area; integration of seamless carsharing technologies; and an emphasis on economic viability.

This paper includes a description of the CarLink I field test results, from which CarLink II builds; an overview of the CarLink II pilot program; a discussion of the CarLink II research goals and study methodology; and an examination of CarLink's niche potential, as a complement to transit and feeder shuttles, in the South Bay.

Index Terms-- Carsharing, advanced technologies, niche market, and economic viability

I. Introduction

Over the last century in the U.S., the automobile grew in popularity and dominance, while transit lost market share. Despite the distinct benefits associated with the auto and traditional transit, service gaps remain between these modes. A shift in local transit policy, fostered by federal ISTEA and TEA-21 legislation, suggests an opportunity may exist for more sustainable market niche services to emerge (1), such as transit feeder shuttles and commuter-based carsharing. Indeed, both carsharing and shuttles are gaining popularity (1, 2, 3). See Shaheen *et al.* (2, 3) for a discussion of the past, present, and future of carsharing internationally.

In the last 15 years, transit feeder services—supported by employers and developers—have emerged to help attract and retain employees and promote travel demand management. In the 1980s, business parks in the East San Francisco Bay region deployed the first rail-based shuttle services, transporting Bay Area Rapid Transit (BART) commuters to and from the Bishop Ranch and Hacienda Business Parks (1). Due to rising costs, however, both programs were repealed in the early 1990s (1). This same region was the home of the 1999 CarLink I field test, based out of BART's Dublin/ Pleasanton station, and linked to the Lawrence Livermore National Laboratory (LLNL) (4).

Today, most commuter subscription services have been taken over by local authorities, employers, or both, and rely on subsidies. In the San Francisco Bay Area, several innovative partnerships between employers and rail transit operators have formed recently to provide feeder services, such as the BART Station Car Program and CarLink (1, 4, 5). Furthermore, in May 2000, BART and Hertz jointly launched a commercial, "station car" rental program at the Fremont station.[1]

Carsharing can be thought of as organized, short-term car rental (2). A commuter-based carsharing model, such as CarLink, could provide connectivity to traditional transit, bridging the gap on either end of a transit trip by offering individuals a shared fleet of vehicles (i.e., Homebased and Workbased Commuters). Furthermore, vehicles are shared by employees at an employment center for multiple uses throughout the day (i.e., Workbased Day Use). On evenings and weekends, vehicles are used by participants (i.e.,

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[1] It is interesting to note that CarLink has its roots in both European carsharing and the U.S. "station car" concept. Bernard (6) defines carsharing and station cars as two separate concepts, though somewhat overlapping. Carsharing, according to Bernard, is a European development that usually begins as a local cooperative with one or two vehicles parked in several residential neighborhoods, which are seldom used for commute trips. The "station car" concept involves several to many cars parked at central locations, such as transit stations and businesses, for subscribers to make local trips. Station cars are typically small electric vehicles for environmental reasons, although other types of vehicles can be used. Under this definition, CarLink is a station car program. As with any developing concept, definitions are evolving. The authors of this paper regard CarLink as a blend of both the station car and carsharing concepts (4).

Homebased Users), who drive them home from transit stations at the end of the workday. Carsharing vehicles can provide a shared community resource at transit stations, neighborhoods, and employment centers to offer access to destinations that are not conveniently accessible by transit alone (7). To facilitate vehicle access and program operations, smart technologies can be utilized.

This paper provides an overview of the CarLink I field test findings. Next, it provides a description of the CarLink II pilot program and the study methodology. Finally, it argues that carsharing can provide a complementary niche service (*not* a replacement) to traditional transit and feeder shuttles and has commercial potential.

II. CARLINK I FIELD TEST OVERVIEW AND FINDINGS

The CarLink I field test was launched on January 20, 1999, and ended on November 15, 1999. Fifty-four individuals enrolled in the program and shared 12 natural gas powered Honda Civics. The participants were from San Francisco, Oakland, and East Bay communities. The cars were based from premium parking spaces at the Dublin/Pleasanton BART station. The model incorporated traditional and reverse commute travel patterns and a day-use fleet application, tested at an employment center (i.e., LLNL).

The CarLink I field test combined short-term rental vehicles with communication and reservation technologies (i.e., smart technologies) to facilitate shared-vehicle access. The ten-month demonstration was implemented and researched by two teams at the Institute of Transportation Studies at the University of California, Davis. Project partners included the California Department of Transportation (Caltrans), American Honda Motor Company, the BART District, Partners for Advanced Transit and Highways (PATH), and LLNL. INVERS (a Germany-based smart carsharing technology company) and Teletrac provided the advanced carsharing and vehicle tracking technologies.

The CarLink model includes three separate user structures: a “Homebased User” lease, transit links for Homebased Users and “Workbased Commuters,” and shared vehicle access at employment sites through “Day Use.” During the field test, each group paid a distinct fee according to the duration of car use. All user fees included fuel, insurance, and maintenance costs. Roadside assistance and an emergency taxi service were also provided. In addition to vehicle support services, CarLink implementation staff supported the program by cleaning and occasionally refueling the vehicles, as well as maintaining e-mail and phone contact with users.

Using questionnaires, household interviews, and focus groups, researchers explored CarLink attitudes and use over time. Although the CarLink I participant sample was small (i.e., 54 enrolled), valuable lessons may still be drawn from the results. CarLink I findings include operational understanding, participant profiles, behavioral findings, preliminary economic analysis, and directions for future research (4). Key study findings are:

- Even though many CarLink users' commutes took longer (on average, approximately 10 minutes longer), they found them less stressful.
- CarLink drivers used personal vehicles less than before they joined the study. Those in the Workbased Commuter group also increased their use of BART for recreational travel, perhaps because they became more familiar with the system and had easier access to it.
- The combination of CarLink, BART, and carpooling resulted in a net commute reduction of approximately 20 vehicle miles (or 32.2 kilometers) per day for CarLink commuters. CarLink also resulted in at least 20 new BART trips each day.
- Participants felt comfortable with the smart technologies used for vehicle access and tracking, and preferred them over available low-tech versions.
- Several Homebased Users said that if CarLink became permanent, they would sell one of their personal cars, which would greatly reduce their transportation costs. Workbased Commuters said they were more hesitant about selling a private vehicle until transit services improved and CarLink supplied more lot locations and vehicle variety (e.g., minivans and pickup trucks).
- Most Workbased Commuters interviewed said that they would return to solo driving after CarLink ended although some would try to carpool more frequently than they had previously (4).

The CarLink II pilot program builds upon these findings. In the next sections, the authors describe the CarLink II program, research goals, and study methodology.

III. CARLINK II PILOT PROGRAM

CarLink II continues the investigation of commuter-based carsharing as developed in the CarLink I field test. However, there are five primary differences between the field test and CarLink II. First, CarLink II is a pilot program that includes a continuation strategy to transition this service to an ongoing carsharing organization, once the initial pilot stage is finished. As mentioned above, researchers found that many CarLink I users would have continued in the program, sold a household vehicle or forgone a purchase, and increased transit and/or alternative mode use (e.g., carpooling and vanpooling) (4). Thus, a more permanent approach was considered critical by CarLink II project partners.

Second, the size of the CarLink fleet increased from 12 to 27 vehicles, consisting entirely of 2001 Ultra Low Emission Vehicle (ULEV) Honda Civics. CarLink II’s larger size enables researchers to gain a more sophisticated understanding of carsharing’s niche potential with greater statistical significance. A third difference is the program’s

focus on providing commuter feeder and day use services to *many* companies in the region rather than one single employer. Fourth, the participation of multiple employers and employees required the development of integrated carsharing technologies, which coordinate vehicle tracking, data collection, and reservations. "Smart keys" now enable instant vehicle access and eliminate the need for multiple "key boxes" at transit stations and work locations. The potential of these technologies to enhance service capabilities and reduce program costs is central to the CarLink II program and to realizing the economic potential of this carsharing model. Finally, CarLink II is located in the Palo Alto region, south of San Francisco, and its chief transit partner is Caltrain (i.e., a commuter rail system that runs for approximately 75 miles between Gilroy and San Francisco). The notable congestion and growth of the South Bay also renders it a prime location for exploring commercial viability.

As in the CarLink I field test, three distinct categories of users share the CarLink II vehicles:

- **Homebased Users,** who have access to the vehicles on evenings and weekends, pay $300 per month. These members live in or near Palo Alto and drive a CarLink vehicle to the Caltrain California Avenue station each weekday morning, before taking a train to work and then home again at night.
- **Workbased Commuters** are employees of Stanford Research Park businesses, who use the CarLink vehicles that Homebased Users parked at Caltrain in the AM, to commute to and from the California Avenue station and their work site. Employers pay approximately $50/month per vehicle for employee access to vehicles. Employers are highly encouraged to promote carpooling among Workbased Commuters.
- **Workbased Day Users** are employed by business subscribers of the Stanford Research Park (i.e., the same companies as for Workbased Commuters) and use the vehicles for personal and business trips throughout the day. Day Use is provided as a subscription package to employers for $300 per vehicle per month.

Again, all user fees include maintenance, insurance, and fuel costs. Roadside assistance and emergency taxi services are also provided. The CarLink implementation staff also supports the program by cleaning the vehicles, as well as maintaining e-mail and phone contact with users.

Since the CarLink II program is focused on understanding the commercial potential of commuter-based carsharing, the identification of enthusiastic employers is vital. Attributes that can promote commuter-based carsharing include:

- Traffic congestion and parking constraints;
- Proximity to transit and transit incentives (e.g., reduced fares);
- Innovative corporate philosophies and/or mandates (e.g., transportation demand management programs);
- Potential to integrate carsharing with current transportation alternatives (e.g., vanpooling); and
- Transit feeder service gaps (e.g., shuttles are not available).

During site selection, the CarLink II team chose to work with one group—the Stanford Research Park[2]—in recruiting employer participants. As its name suggests, the Stanford Research Park primarily houses research companies, whose type and size varies widely. There are high-tech law firms, software companies, pharmaceutical research companies, and several "dot coms."

The companies most interested and suited to CarLink II participation include those with regular work schedules (in contrast to "dot coms") and range in size between 100 to 600 employees. CarLink II includes five to six employers, located throughout the Stanford Research Park. The next section describes the CarLink II study goals and research methodology.

IV. STUDY GOALS AND RESEARCH METHODOLOGY

The CarLink II evaluation builds upon the research of the CarLink longitudinal market survey and field test (4, 7). As in the CarLink I field test, the current research investigates the perceptions and attitudes of carsharing participants through focus groups, questionnaires, and household interviews, as well as examining changes in travel patterns by comparing travel diaries and automatically collected data. The present study expands upon the previous survey by examining the modified CarLink model and by increasing attention to cost issues (e.g., users' willingness-to-pay and perceived value of various CarLink features); CarLink commercial potential; and evaluation and refinement of the smart technologies. This research will provide valuable information to aid in the design of future carsharing systems, as well as helping to improve and transition the on-going CarLink II pilot project to a permanent enterprise. The primary study instruments and methodology are outlined below.

Focus groups were the first research instrument employed; two were conducted several months preceding the CarLink II launch to investigate carsharing perceptions and gather feedback on final design details (e.g., costs and recruitment techniques). These focus groups were used to collect rich qualitative data from participant and moderator interactions. They also allowed researchers to monitor the level of emotion or enthusiasm for a subject; these data proved invaluable to the CarLink system design. The focus groups consisted of individuals living in the Palo Alto area (i.e., potential Homebased Users), recruited at Caltrain stations and through "cold call" telephone recruitment. Focus

[2] Stanford Research Park has over 700 acres and 10 million square feet of developed facilities, 162 buildings, 150 companies, and 23,000 employees.

groups are also planned with program participants mid-way and at the end of the evaluation period.

The second research instrument consists of a questionnaire series, beginning when participants join CarLink II, another mid-way during their first year, and one at the conclusion of the data collection period or when they leave the program. To complement the advanced nature of CarLink II, questionnaires are conducted on-line. While Internet surveys are becoming more commonplace in marketing fields, few transportation projects have used web-based questionnaires (e.g., exceptions include the REACT! web-based Computer Assisted Self-Administered Interview project at UC Irvine or the Computerized Household Activity Scheduling Elicitor (CHASE) software program at the University of Toronto) (8, 9). By answering questions on-line, data entry and analysis are streamlined. Ideally, an on-line questionnaire combines the best features of mailback surveys, which often entail low return rates yet accurately completed, and telephone interviews that have better completion rates but suffer from a respondent's desire to terminate the interview quickly (10, 11, 12). As with a mailback survey, respondents are able to complete computerized questionnaires when their schedule permits, but they avoid mailing hassles.

Along with a few basic socio-demographic questions about household characteristics, initial survey instruments address each household's pre-CarLink travel patterns. Researchers will compare these responses to participant travel diaries (see below). Furthermore, respondents also answer a series of psychographic questions related to their opinions and attitudes about transportation and other items (e.g., environment, advanced technologies, and willingness to try new things).

The third research instrument is a three-day travel diary (i.e., two consecutive weekdays and a weekend day). To evaluate CarLink's effectiveness in decreasing congestion, reducing air pollution, lowering parking space needs, and increasing transit ridership, researchers need to know how members traveled before and during the program. Before joining CarLink II, all participants are required to complete an on-line travel diary, assisted by a small "memory jogger," which they carry with them over the three days and reference when submitting their on-line diary. Subsequently, researchers compare the pre-CarLink travel data to CarLink vehicle usage data collected automatically, as well as travel diaries completed as part of the CarLink II evaluation.

The CarLink in-vehicle technology provides the fourth study instrument, collecting usage data automatically. These data can be viewed in real-time (i.e., the fleet manager can monitor vehicles at any time) and are archived to provide usage histories. Data include:

- User ID;
- Start and end times;
- Start and end locations; and,
- Fuel level (to an eighth of a tank).

CarLink researchers use these data to calculate total vehicle miles traveled, trip number, fuel used, time of use, and other statistics.

At the end of the evaluation period, researchers will prepare an overall program and economic assessment, based on cost and revenue records (i.e., both monetary and in-kind). These data will be used to predict CarLink II's economic forecast, under various scenarios, and describe user behavior and satisfaction during program operation. The final report will also consist of the CarLink implementation team's lessons learned from the program design phase, recruitment, and implementation. As CarLink II develops from an experimental pilot project into a stand-alone operation, this analysis will aid in deciding future directions and economic promise. The final section of this paper explores the potential of commuter-based carsharing to provide a complementary, niche service to traditional transit and feeder shuttles.

V. CARSHARING AND FEEDER SERVICES: COMPLEMENTARY SERVICES

Today, transit feeder shuttle services continue to gain popularity in Northern California, with over 100 shuttles in the Bay Area (1). In the San Francisco Bay Area, transit feeder shuttles cost approximately $75,000 to $80,000 per year to operate. Typically, they include peak-period services and are often timed with transit schedules to reduce wait times. Although feeder shuttles are quite successful in the Bay Area, service limitations do exist. These service gaps provide a complementary niche for commuter-based carsharing programs.

The Caltrain California Avenue Station, located in Palo Alto, is currently served by a number of shuttles. They consist of the Stanford University Marguerite, Palo Alto Crosstown, Palo Alto Embarcadero/Baylands, and the Deer Creek employer shuttles. The most pertinent to CarLink are the Palo Alto Embarcadero/Baylands and Deer Creek employer shuttles, which were designed to transport employees from a transit station to their work site. These shuttles provide timed transfers with Caltrain and run only at peak times.

The Embarcadero/Baylands shuttle operates from the Caltrain station to the Baylands work site. Initially, there was only one shuttle in operation. In late 1999, however, the city of Palo Alto supported the expansion of this service and a second shuttle was added. Currently, the city deploys the shuttles between 9:30 AM and 3 PM on a second route, known as the Palo Alto Crosstown Shuttle service.[3] The

[3] The Embarcadero shuttle cost approximately $250,000 (total) to run in 2000, which was largely subsidized by Caltrain due to the commute portion of the route. Approximately 115 people use the crosstown shuttle

second employer shuttle, Deer Creek, operates between the California Avenue Caltrain station and Deer Creek employment sites, such as Hewlett-Packard and Agilent Technologies.

Funding for the Embarcadero/Baylands and Deer Creek shuttles started with employers providing 25 percent of the total cost. Typically, a coalition of companies, led by one employer, funds the shuttle. The Joint Powers Board (JPB) and the Bay Area Air Quality Management District (BAAQMD) cover the remaining costs (i.e., 75 percent). JPB is a three-county agency consisting of SamTrans, the Valley Transportation Authority (VTA), and the San Francisco Municipal Railway (Muni). SamTrans is the San Mateo County transit authority, providing service throughout the county with connecting services to San Francisco and Palo Alto. VTA represents the valley transit authority of Santa Clara County. Finally, Muni provides train, bus, and cable car services in San Francisco. Combined, the three departments form the JPB, and they operate Caltrain in addition to the Palo Alto shuttles.

JPB gets a portion of its funding from the Transportation Fund for Clean Air (i.e., Assembly Bill (AB) 434 funds). AB 434 funds are generated from California vehicle registration fees to support air quality management programs, such as feeder shuttles. It is important to note, however, that these funds are limited. Due to an increasing number of applications by transit organizations in recent years, requirements have become more stringent. The two Palo Alto employer shuttles described above receive enough money from the BAAQMD to alleviate approximately 25 percent of total costs. The remaining 50 percent are covered by JPB.

There are six main reasons CarLink could provide a complementary service to traditional transit and feeder shuttles. First, many San Francisco Bay Area shuttles include only a single van, circulating from a transit station to one or more employment sites during peak commute periods. Since shuttle capacity is somewhat limited, there is a potential for unmet demand. CarLink could supplement such services and perhaps attract customers who are unwilling to take a shuttle service for a variety of reasons (e.g., flex hours, unpredictable schedules, or preference for personal vehicles).

Second, subsidized funding is limited and highly competitive. Thus, the number of subsidized shuttle services deployed in a region each year is limited. Indeed, it is not uncommon that employers are unable to secure a shuttle service in a highly congested region, such as Silicon Valley. Furthermore, many smaller employers (the predominant model in Silicon Valley) are unable to support a shuttle service. CarLink could serve employers of almost any size (by scaling the number of vehicles contracted) without the level of local subsidy required by a traditional feeder shuttle service. It is important to note here that CarLink vehicles could carry up to five passengers (carpooling is highly encouraged and facilitated by advanced technologies in CarLink II).

Third, timed shuttles can only provide connectivity to individuals whose schedules are within service hours. Individuals who work late or have variable hours are typically unable to use a shuttle service. CarLink can provide a more demand-responsive alternative to individuals who may need to travel at times different than those covered by the shuttle service.

Fourth, shuttles normally operate only during peak periods; thus, individuals who vanpool, carpool, or take transit are typically restricted to the work site during the day. Even if shuttles do run during off-peak hours, the choice of destinations is restricted. In addition to providing a more demand-responsive alternative, CarLink could also provide a supplementary mobility option to individuals who carpool or take transit by offering an on-site vehicle fleet for business and personal trip making during the day. During the CarLink I field test, researchers found that the fleet increased the mobility options of participants who biked, carpooled, vanpooled, or took transit to work, allowing them to drive alone to work less (4).

Fifth, feeder shuttles mainly serve only one side of a transit commute (i.e., either residential or business). In the case of employer-based shuttles, services are typically limited to a few employees during peak periods. With CarLink, the same vehicle fleet can serve both “Homebased Users” and “Workbased Commuters.”

Finally, CarLink offers a parking management solution to transit providers since shared-use vehicles can serve multiple transit customers per day with a single parking space. Hence, CarLink can give transit providers a means of attracting new customers while making a more efficient use of their parking spaces. Based on these arguments, the authors support that a potential niche market exists for commuter-based carsharing, which is complementary to existing services.

To support this analysis, researchers also interviewed three local transit providers—AC Transit, Muni, and Golden Gate Transit—to assess whether CarLink might be a complementary alternative to their services. Although interview results are not definitive, respondents stated that when suburban feeder services (i.e., door-to-door services) do *not* exist or commuters refuse to take transit, CarLink could provide a complementary service. Furthermore, if CarLink offered transit customers (e.g., bus riders) access to a vehicle during the day at work sites, encouraging continued transit patronage, it would also be beneficial. However, if CarLink were used to replace existing transit or door-to-door shuttle services, it would be competitive. Based on these arguments, the authors support that a potential niche market for commuter-based carsharing

during the week, and 100 use it on Saturdays. However, funding for the crosstown shuttle will likely be cut after July 2001.

exists, particularly in suburban locations where bus and shuttle services are unavailable.

VI. CONCLUSION

Today, carsharing and transit shuttles are gaining popularity as modal alternatives that provide connectivity and increase transit use. This paper explores the potential of commuter-based carsharing to fill key transportation service gaps, the CarLink I field test results, and CarLink II's role in further understanding this transportation alternative. While the CarLink I field test focused on user response and system performance, CarLink II focuses on market and economic potential, as well as the role of advanced technologies in facilitating system use/management and reducing program costs.

Carsharing has the potential to become an economically viable, demand-responsive service to complement existing transit and shuttle services. Carsharing's commercial potential is appealing since shuttle vans rely heavily on subsidies (i.e., approximately 75 percent of total costs).

In conclusion, CarLink II will help to test commuter-based carsharing's market niche potential in two main ways. First, it will evaluate user demand and satisfaction, building upon the findings of the CarLink I field test. Second, researchers will assess CarLink II's economic potential based on this deployment. For such carsharing services to expand, they must be able to thrive with minimal outside support. CarLink II provides a new test bed for answering these key questions.

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